Newlands Project Planning Study
Draft Special Report

Prepared by

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Mid-Pacific Region
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Bureau of Reclamation

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Executive Summary

The Newlands Project Planning Study (Study) Special Report is a study conducted by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation). The Study's intent is to formulate, develop, and evaluate a range of alternatives to deliver water to Newlands Project (Project) water rights holders while also reducing risk to local communities from operating the Project's Truckee Canal. The purpose of this Special Report is to describe that process and present Study findings.

Planning studies help identify and evaluate different ways to address a problem or issue in a manner that could be supported by decision makers, stakeholders, and Congress before funding more detailed studies or projects. Thus, the results of this Study may be used to inform decisions regarding the Newlands Project, including the extent of repairs to the Truckee Canal and its future operation; the report is informational only and is not intended to provide a specific recommended action. If Congress chooses to authorize and appropriate funds in the future for a feasibility study, construction, or other activities, this report would provide important context and guidance for undertaking those activities and any related environmental reviews.

Background

The Newlands Project is one of Reclamation's first irrigation projects and nearly as old as the agency itself. Reclamation began the Project in 1903 to provide irrigation water to the Lahontan Valley, near Fallon, Nevada, and to lands in the Truckee Basin near Fernley, Nevada.

In the early morning of January 5, 2008, a 50-foot portion of the Truckee Canal embankment failed about 12 miles downstream from Derby Dam, releasing water that inundated a residential development in the City of Fernley, flooding 590 properties. No fatalities occurred, but more than $1 billion in tort claims were filed against the Federal government, local governments, and the Truckee-Carson Irrigation District (TCID), and have now been consolidated into class-action lawsuits.

Although the damaged portion of the canal embankment was soon repaired, evaluations of the canal revealed a high potential for future failure. In response, Reclamation imposed restrictions on the water surface elevation allowed in the canal and the amount of water allowed to flow through the canal. The flow restrictions were reinforced by the Federal District Court for Nevada. If not lifted, these restrictions could complicate the long-term ability of Reclamation to provide Newlands Project water rights holders with reliable supplies.

Federal authorization for the Study was provided in the *Omnibus Appropriations Act of 2009* (Public Law 111-8, 123 Statute 609), which directed Reclamation to determine the actions necessary to rehabilitate the Truckee Canal so restrictions on its operation can be removed.

Existing and Future Conditions

The primary study area for this investigation consists of the Newlands Project boundaries, TCID service area in the Newlands Project, Churchill County, the City of Fernley in northern Lyon County, the Fallon Paiute-Shoshone Indian Reservation, the Stillwater National Wildlife Refuge (NWR), and the Carson Lake and Pasture. The extended study area encompasses the broader Carson River watershed, Truckee River watershed, and Dixie Valley. These areas encompass Lake Tahoe, Pyramid Lake, a number of cities and communities, as well as the majority of the Pyramid Lake Indian Reservation. Figure ES-1 shows both the primary and extended study areas.

This Study describes existing and likely future without-action conditions in the primary and extended study areas. The description of these conditions includes information available to the Study on infrastructure; physical, biological, cultural, socioeconomic environments; and water resources.

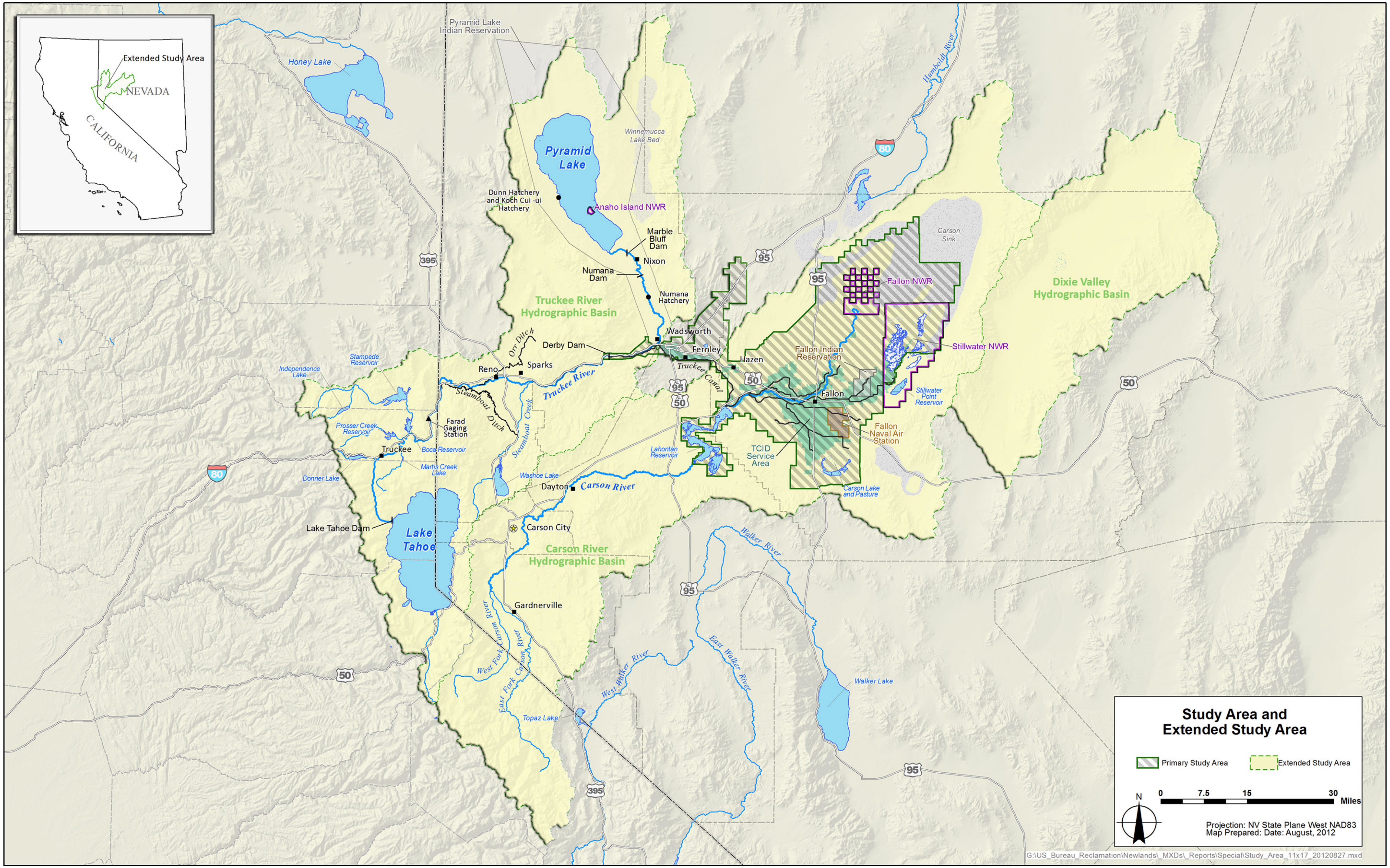

Figure ES-1. Study Areas for the Newlands Project Planning Study

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Problems, Needs, and Opportunities

Major water resources problems and needs for the Study pertain to the increasing competition for water rights in the Truckee and Carson river basins, increases in the likelihood and potential consequence of a Truckee Canal breach, and the reliability of Project water rights. Opportunities have been identified during the Study relative to Project efficiency and water quality and quantities on the Lower Truckee River.

Water Rights Related Needs

Reclamation and its local contractor, TCID, are obligated to serve Project water rights holders. However, the Project's changing makeup has complicated the delivery of water to its diverse blend of users. Over the last century, several factors, including urban growth in Fallon and Fernley and the decline of ecosystems in the primary and extended study areas, have increased competition for water in the Truckee and Carson river basins and reduced the proportion of Project water delivered for agricultural uses relative to other uses. While these changing demands are not considered a problem, serving Project water rights holders is an important need.

Truckee Canal Risk Related Problems and Needs

As evidenced by the 2008 breach, operating the Truckee Canal in its current condition to serve Project water rights holders presents large safety risks for residents and property, particularly in the Fernley area. The breach in 2008 was not the first structural failure of the Truckee Canal – eight other breaches occurred during the twentieth century. However, all of the previous breaches had occurred in rural areas or at a time when the property adjacent to the canal was uninhabited.

Since 2008, Reclamation has reviewed the risks of continuing to operate the Truckee Canal and has concluded that substantial improvements will be needed to allow the canal to safely convey as much water as it has historically. The facility's advanced age – around 110 years old – and structural issues make future breaches likely. Urbanization has increased the potential for a breach to cause damage, injuries, or deaths. The combination of failures with high likelihoods and with high consequences has led Reclamation to require extensive rehabilitation actions, especially for the urbanized portions of the Truckee Canal. In the meantime, while options for reducing risk are being formulated and discussed, Reclamation has restricted the flow stages of the Truckee Canal.

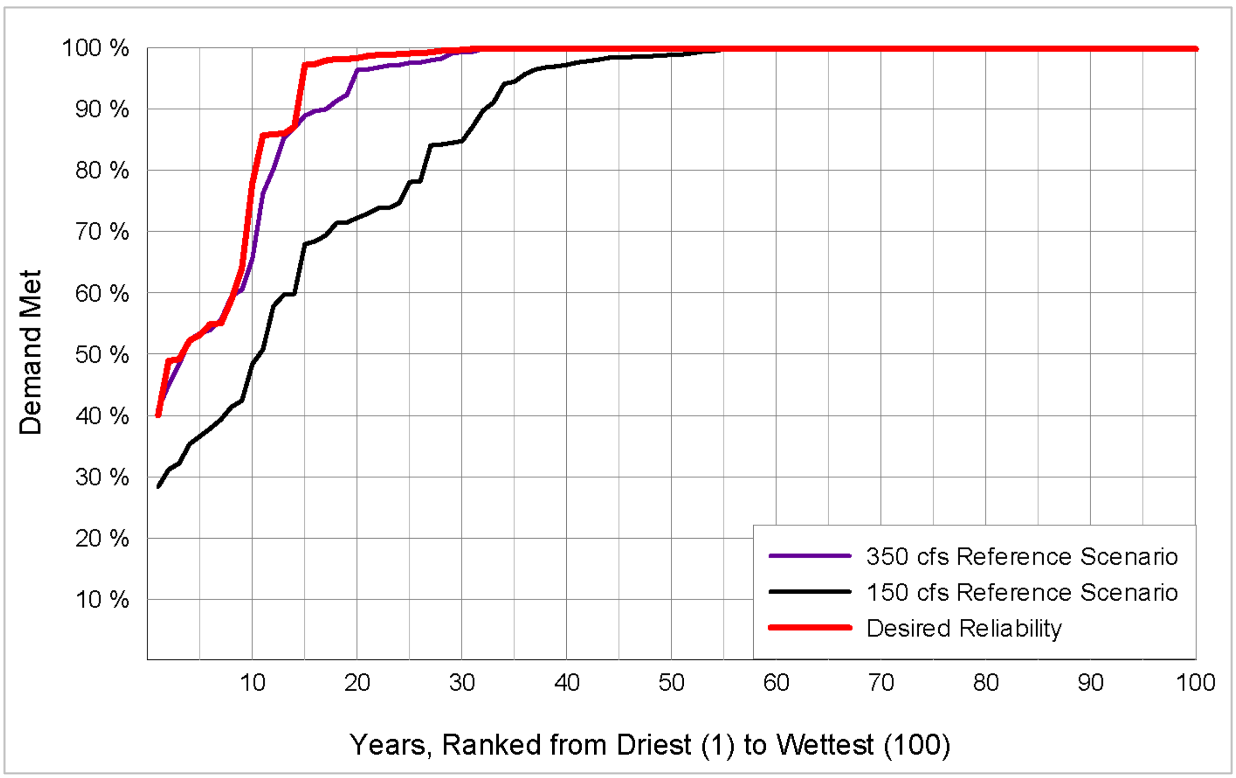
Water Supply Reliability Related Problems and Needs

Restrictions on flow through the Truckee Canal, aimed at addressing Reclamation concerns for safety and risk, could reduce Project water supply to levels below the conditions experienced by users before the 2008 Truckee Canal breach.

The potential for reduced Truckee Canal capacity to affect Project water supply is illustrated in Figure ES-2, which depicts 100 years of simulated water supply deliveries to Project water rights holders under different canal flow-stage scenarios, including:

- **Desired Reliability Scenario** – Represents the range of water supply conditions that Project water rights holders could have expected, had the 2008 canal breach not resulted in capacity restrictions.

- **150 cfs and 350 cfs Scenarios –** Illustrates the anticipated water supply conditions that Project water rights holders might experience in the future, with flow-stage restrictions on the Truckee Canal of 150 and 350 cfs. These two selected flow stages (350 and 150 cfs) bracket the range of recent and likely future restrictions on the Truckee Canal, respectively.



Notes:
Simulations based on 100-year hydrology for the Truckee and Carson river basins, 1901–2000.
The Desired Reliability scenario considers the current Project demand; the other scenarios consider anticipated future demand, as discussed in Chapter 3 and Appendix C.
Key:
cfs = cubic feet per second

Figure ES-2. Potential for Restricted Truckee Canal Capacity to Affect Water Supply Reliability for the Newlands Project

Project Efficiency Related Opportunities

As Reclamation and others have long noted, many Project features and practices result in the inefficient use of Project water. For instance, the Project's aged conveyance structures, most of which are unlined, permit large amounts of water to seep into the ground before delivery. Conditions such as these present opportunities to improve the Project's efficiency by reducing delivery system losses, or otherwise improving the Project's ability to deliver more with its existing water supplies.

Lower Truckee River Related Opportunities

Conflict and litigation over surface water in the Truckee River Basin have been ongoing for more than 100 years, and the Newlands Project has been a frequent component of these disputes. Chief among these disputes is litigation stemming from reductions to Pyramid Lake elevations and fish species. A number of factors have reduced the cumulative inflows from the Truckee River to Pyramid Lake, thereby challenging the viability of these fisheries. Over time, Project diversions from the river at Derby Dam have become the focus of efforts to reverse declines in water levels at Pyramid Lake and water quality in the Lower Truckee River. The result of these efforts has been a significant reduction in Project diversions from the Truckee River, in comparison to historical practices.

Study Objectives

On the basis of specific direction in the Study's authorizing legislation, identified water resources problems and opportunities in the study areas, and other guidance, the following Study objectives were developed:

- Address Truckee Canal safety concerns in a manner that is consistent with Reclamation's preferred standards of safety for canals.

- Satisfy the exercise of future anticipated Project water rights in a manner equivalent to the level of service reliability Project users would have experienced historically, under current regulations and without restrictions on the Truckee Canal. Further, provide water rights reliability in a manner that maintains the viability of the Project, meaning that the Project's current ability to generate revenue and sustain itself is preserved.

Alternatives were formulated specifically to accomplish the Study objectives. To the extent possible, through pursuit of the Study objectives, alternatives also include features to help address the following opportunities:

- Improve the efficiency of Project water supply deliveries.

- Improve the water supply quantity and quality of the lower Truckee River.

Specific planning constraints, considerations, and criteria were also established to help guide the Investigation planning process.

Formulation and Evaluation of Alternatives

Once water resources problems, needs, and opportunities have been identified, and planning objectives, constraints, considerations, and criteria have been developed, the next major elements of the plan formulation process are identifying and screening management measures, and formulating alternatives to meet the Study objectives.

Screening Management Measures

A management measure is any structural or nonstructural action or feature that could address one or more planning objectives, consistent with other planning considerations, criteria, and constraints. At each step of the planning process, measures are reviewed, and in some cases reconsidered and incorporated into alternatives or eliminated from further consideration.

More than 50 measures were identified to address the Study objectives and opportunities, based upon previous studies, reports, public input, and meetings with stakeholders and agencies in the study area. The Study subjected all measures to a three-phased screening process that included:

- **Phase 1 –** Removal of measures with seemingly intractable implementation hurdles, severe environmental effects that may outweigh safety or water supply benefits, or poor performance relative to magnitude of identified problems.

- **Phase 2 –** Technical analysis of measures that passed Phase 1, but which had not been evaluated by previous studies or reports in sufficient detail for evaluating relative performance, and removal of poor performers from further consideration.

- **Phase 3 –** Combination of measures into preliminary alternatives, and removal of measures that have lower performance relative to similar alternatives or compatibility problems.

Seven measures were retained for meeting the safety objective among five potential Truckee Canal conveyance capacities, and 11 additional measures were retained for meeting the water supply objective, including one measure that was retained in concept only. All measures retained for use in preliminary alternatives are listed in Table ES-1.

Table ES-1. Measures Addressing Study Objectives

Study Objective: Truckee Canal Safety [1,2]
Provide Safety at 600 cfs [1, 2]
High Density Polyethylene cutoff walls along the Truckee Canal
Provide Safety at 350 cfs [1, 2]
High Density Polyethylene cutoff walls along the Truckee Canal
Concrete/Geomembrane lining along the Truckee Canal
Provide Safety at 250 cfs [1, 2]
High Density Polyethylene cutoff walls along the Truckee Canal
Concrete/Geomembrane lining along the Truckee Canal
Provide Safety at 150 cfs [2]
Operate with Restricted Truckee Canal
Provide Safety at 0 cfs
Decommission the Truckee Canal
Study Objective: Water Supply
Develop Supplemental Sources of Water Supply
Treat and deliver City of Fernley Municipal Effluent
Import Groundwater Supplies from Dixie Valley
Construct Pipeline for Supplying Truckee Canal
Increase Delivery Efficiencies by Reducing Seepage Losses
Line Main Canals and Laterals in the Carson Division
Compact Soils of Main Canals and Laterals in the Carson Division
Concrete/Geomembrane Lining Along the Truckee Canal[1]
Compact soils of Truckee Canal
Reduce Dry-Year Agricultural Demand
Acquire and Permanently Retire Project Water Rights
Crop Insurance/Dry Year Fallowing
Partial Season Forbearance Agreements
Develop Upstream Truckee River Storage
Multi-Year Upstream Storage (*retained in concept only)*

Notes:

[1] Many measures retained for addressing Truckee Canal Safety Risks are distinguished by the type of improvements performed along the canal, but also include other structural refurbishments and non-structural activities that are consistent across all indicated measures.

[2] Aside from decommissioning the Truckee Canal, all measures retained for addressing Truckee Canal Safety Risks also have performance characteristics that help provide Newlands Project with Water Supply Reliability.

Refinement of Alternatives

As part of the measures screening process, 24 preliminary alternatives were developed for addressing the Study objectives. Figure ES-3 illustrates how measures from various subcategories were combined to achieve the water supply objective (illustrated as the Desired Reliability line). The preliminary alternatives are illustrated in ES-3 in the same sequence and order as they are described in Tables ES-2. Preliminary alternatives are labeled with a flow stage and letter (e.g. 350.a is the first preliminary alternative with a 350 cfs flow stage).

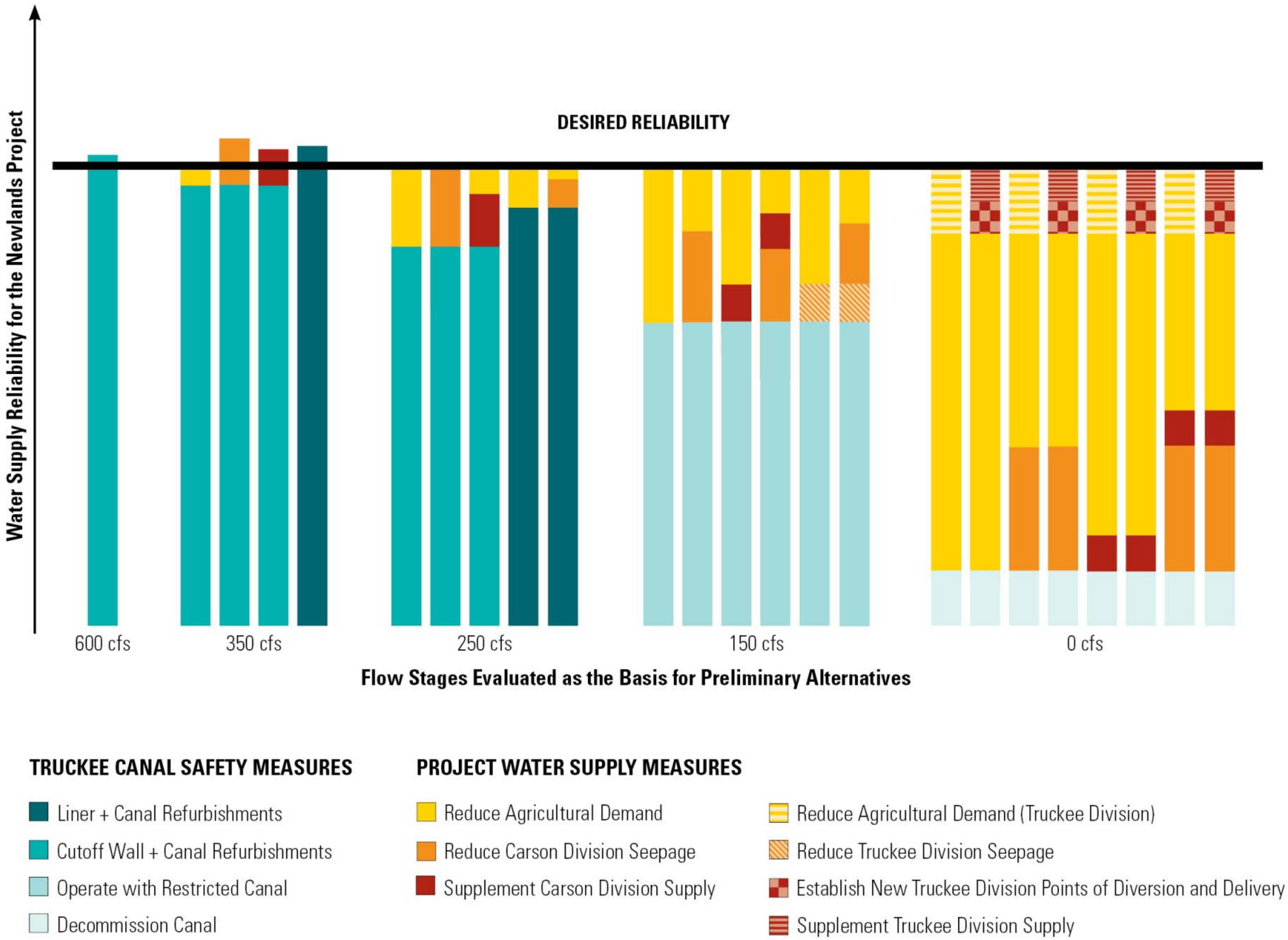


Figure ES-3. Summary of Preliminary Alternatives Assembled to Achieve Safety and Water Supply Reliability

Table ES-2. Summary of Preliminary Alternatives between Flow Stages of 600 cfs and 150 cfs

Truckee Canal Flow Stage		Measures Selected to Meet Objectives: Safety	Water Supply: Primary Measure	Water Supply: Additional Measure(s)	Est. Annual Cost ($ Million)[1,2]: Low	Est. Annual Cost ($ Million)[1,2]: High
600 cfs		HDPE Cutoff Wall	None		$2.10	$2.10
350 cfs	a	HDPE Cutoff Wall	Reduce Agricultural Demand *(5 to 15%, 2 measures)*	None	$2.50	$3.90
	b	HDPE Cutoff Wall	Reduce Carson Division Seepage *(2 measures)*	None	$2.60	$10.00
	c	HDPE Cutoff Wall	Supplement Carson Division *(1 measure)*	None	$6.50	$13.00
	d	Concrete/ Geomembrane Liner	None		$2.80	$2.80
250 cfs	a	HDPE Cutoff Wall	Reduce Agricultural Demand *(20 to 25%, 2 measures)*	None	$3.70	$5.10
	b	HDPE Cutoff Wall	Reduce Carson Division Seepage *(2 measures)*	None	$2.60	$10.00
	c	HDPE Cutoff Wall	Supplement Carson Division Supply *(1 measure)*	ReduceAgriculturalDemand*(10to15%,2measures)*	$7.30	$15.00
	d	Concrete/ Geomembrane Liner	Reduce Agricultural Demand *(10 to 15%, 2 measures)*	None	$3.60	$5.20
	e	Concrete/ Geomembrane Liner	Reduce Carson Division Seepage *(2 measures)*	ReduceAgriculturalDemand*(0to10%,2measures)*	$3.30	$5.10

Table ES-2. Summary of Preliminary Alternatives between Flow Stages of 600 cfs and 150 cfs (contd.)

Truckee Canal Flow Stage		Measures Selected to Meet Objectives				Est. Annual Cost ($ Million)[1,2]	
		Safety	Water Supply				
			Primary Measure	Additional Measure(s)		Low	High
150 cfs	a	Maintain Flows at or Below Flow Stage	Reduce Agricultural Demand *(35 to 45%, 2 measures)*	None		$2.90	$5.30
	b		Reduce Carson Division Seepage *(2 measures)*	Reduce Agricultural Demand *(15 to 25%, 2 measures)*		$1.70	$11.00
	c		Supplement Carson Division Supply *(1 measure)*	Reduce Agricultural Demand *(25 to 35%, 2 measures)*		$6.40	$15.00
	d		Reduce Carson Division Seepage *(2 measures)*	Supplement Carson Division Supply*(1 measure)*	ReduceAgriculturalDemand*(0to25%,2measures)*	$4.90	$22.00
	e		Reduce Truckee Division Seepage *(1 measure)*	Reduce Agricultural Demand *(25 to 40%, 2 measures)*		$2.20	$4.90
	f		Reduce Truckee Division Seepage *(1 measure)*	Reduce Carson Division Seepage *(2 measures)*	ReduceAgriculturalDemand*(15to30%,2measures)*	$1.90	$12.00

Notes:

[1] Cost estimates have been formatted to indicate the annual cost of implementing each preliminary alternative, relative to the full range of costs developed for preliminary alternatives. Green represents lower costs (lowest being $1.7 million), red represents higher costs (highest being $22 million), and yellow represents mid-range costs.

[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure). See Appendix E2 for additional information.

Key:

cfs = cubic feet per second

HDPE = High Density Polyethylene

Table ES-3. Components of 0 cfs Preliminary Alternatives by Division

Focus of Component		Measures to Meet the Water Supply Objective			Est. Annual Cost ($ Million)[1]	
		Primary Measure	**Additional Measure(s)**		**Low**	**High**
Carson Division	a	Reduce Agricultural Demand *(70 to 80%, 2 measures)*	None		$5.60	$10.00
Carson Division	b	Reduce Carson Division Seepage *(2 measures)*	Reduce Agricultural Demand *(60 to 70%, 2 measures)*		$5.20	$15.00
Carson Division	c	Supplement Carson Division Supply *(1 measure)*	Reduce Agricultural Demand *(60 to 70%, 2 measures)*		$9.10	$18.00
Carson Division	d	Reduce Carson Division Seepage *(2 measures)*	Supplement Carson Division Supply *(1 measure)*	Reduce Agricultural Demand *(50 to 60%, 2 measures)*	$8.80	$25.00
Truckee Division	y	Reduce Agricultural Demand *(100%, 1 measure)*	None		$1.00	$1.00
Truckee Division	z	Establish New Truckee Division Points of Diversion and Delivery *(1 measure)*	Supplement Truckee Division Supply *(2 measures)*		$8.40	$11.00

Note:

[1] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure). See Appendix E2 for additional information.

Key:

cfs = cubic feet per second

Table ES-4. Summary of Preliminary Alternatives for a Flow Stage of 0 cfs

Truckee Canal Flow Stage		Measures Selected to Meet Objectives			Est. Annual Cost ($ Million)[1,2]	
		Safety	Water Supply			
			Components Selected		Low	High
0 cfs	ay	Decommission Truckee Canal	Carson Division 0.a	Truckee Division 0.y	$6.60	$11.00
	az			Truckee Division 0.z	$14.00	$21.00
	by		Carson Division 0.b	Truckee Division 0.y	$6.20	$16.00
	bz			Truckee Division 0.z	$13.60	$26.00
	cy		Carson Division 0.c	Truckee Division 0.y	$10.10	$19.00
	cz			Truckee Division 0.z	$17.50	$29.00
	dy		Carson Division 0.d	Truckee Division 0.y	$9.80	$26.00
	dz			Truckee Division 0.z	$17.20	$36.00

Notes:

[1] Cost estimates have been formatted to indicate the annual cost of implementing each preliminary alternative, relative to the full range of costs developed for preliminary alternatives. Green represents lower costs (lowest being $6.2 million), red represents higher costs (highest being $36 million), and yellow represents mid-range costs.

[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure). See Appendix E2 for additional information.

Key:

cfs = cubic feet per second

Agency Review of Preliminary Alternatives and Screening Criteria

Once preliminary alternatives were developed, the Study team sought the review of agencies and tribes, which presented opportunities for these entities to:

- Understand how measures identified for consideration in the Study have been characterized and analyzed, and suggest revisions to the characterizations of particular measures used in preliminary alternatives.
- Contribute to the descriptions of the preliminary alternatives and identify the potential for benefits or negative impacts associated with each.
- Identify or clarify how screening criteria could be used in selecting and refining Study alternatives.
- Provide feedback on priorities for remaining analyses in the Study.

Inclusion of agencies in the review and assessment of the preliminary alternatives also promotes the Study's intent, which is the development of plans for meeting Study objectives that, ultimately, may be implemented by local, regional, State, and/or Federal partners.

Selection of Study Alternatives

Following the agency review of preliminary alternatives and selection criteria, the planning criteria from the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) was further applied to screen down the preliminary alternatives and select among them for further analysis. These criteria include completeness, effectiveness, efficiency, and acceptability.

This step reduced the number of options available for consideration before proceeding with more detailed evaluation of alternatives. It further leverages the criteria that have been used in the identification of preliminary alternatives that are the most suitable for a more rigorous analysis. The following section discusses how the preliminary alternatives were viewed under each of the planning criteria.

Table ES-5 displays the results of the process to apply the criteria to the preliminary alternatives.

Table ES-5. Summary of Preliminary Alternatives Performance Against Criteria

Alt.	Completeness	Effectiveness	Efficiency	Acceptability	Retained for Further Consideration
600	High	High	High	Varies by Stakeholder and Agency	Yes
350.a	High	High-to-Medium	High-to-Medium	Medium	Yes
350.b	High	High-to-Medium	High-to-Medium		Yes
350.c	High	High-to-Medium	Low		
350.d	High	High-to-Medium	High-to-Medium		Yes
250.a	High	High-to-Medium	High-to-Medium	Medium-to-Low	Yes
250.b	High	High-to-Medium	High-to-Medium		Yes
250.c	High	High-to-Medium	Low		
250.d	High	High-to-Medium	High-to-Medium		Yes
250.e	High	High-to-Medium	Low		
150.a	Low	Low	High-to-Medium	Varies by Stakeholder and Agency	
150.b	Low	High-to-Medium	High-to-Medium		
150.c	Low	High-to-Medium	Low		
150.d	Low	High-to-Medium	Low		
150.e	Low	High-to-Medium	Low		
150.f	Low	High-to-Medium	Low		
0.ay	Low	Low	Low	Varies by Stakeholder and Agency	
0.az	Medium-to-Low	Low	Low		
0.by	Low	Low	Low		
0.bz	Medium-to-Low	Low	Low		
0.cy	Low	Low	Low		
0.cz	Medium-to-Low	Low	Low		
0.dy	Low	Low	Low		
0.dz	Medium-to-Low	Low	Low		

Key:
Alt. = Alternative Name

Scale

Lower Performance — Higher Performance

Alternatives Evaluations and Comparisons

Once the seven Study alternatives were selected, the following evaluations were performed for each: water supply operations modeling, hydropower generation modeling, preliminary environmental and regulatory review, engineering and cost estimates, and financial and preliminary benefits estimates.

Table ES-6 summarizes the features, performance, and evaluations for each Study alternative.

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Table ES-6. Summary of Study Alternatives

		Alternative 600	Alternative 350.a	Alternative 350.b	Alternative 350.d	Alternative 250.a	Alternative 250.b	Alternative 250.d	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	600 cfs	350 cfs	350 cfs	350 cfs	250 cfs	250 cfs	250 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	HDPE Cutoff Wall	HDPE Cutoff Wall	HDPE Cutoff Wall	Lining	HDPE Cutoff Wall	HDPE Cutoff Wall	Lining	-	NA
	Other Features	-	-	Lining 45 miles of Carson Division canals	-	Fallowing 25% in Dry Years	Lining 45 miles of Carson Division canals	Fallowing 10% in Dry Years	-	NA
Safety		Meets RR3	Meets RR3	Meets RR3	Meets RR3	Meets RR3	Meets RR3	Meets RR3	Uncertain[1]	NA
Average Annual Project Water Delivery[2] (percent)		96.5%	95.6%	97.3%	96.3%	95.7%	96.2%	95.5%	90.5%	94.6%
Average Annual Project Water Delivery by User Category	Ag/Irrigation (TAF)	118.3	117.2	119.2	118.0	112.4	118.0	115.4	111.2	NA
	M&I (TAF)	13.3	13.3	13.4	13.3	13.3	13.3	13.3	13.2	NA
	Lahontan Valley Wetlands[3] (TAF)	68.0	67.3	68.6	67.8	67.4	67.8	67.2	63.6	NA
Annual Cost[4] (millions)		$2.90	$2.90	$15.00	$4.20	$6.50	$14.50	$5.60	NA	NA
TCID Ability-to-Pay[5] (millions)		$7.30	$6.90	$7.40	$7.20	$6.90	$7.00	$6.90	$5.00	NA[6]
Hydropower Generation Revenue (millions)		$1.35	$1.35	$1.25	$1.35	$1.30	$1.25	$1.30	$1.20	-
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[7]	12.6	12.1	14.3	13.2	11.6	13.9	12.7	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[8]	Significant change not anticipated	Significant change not anticipated	Reduced by lining Carson Division canals	Significant change not anticipated	Reduced by fallowing	Reduced by lining Carson Division canals	Reduced by fallowing	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[9] (percent)	115%	108%	108%	56%	105%	105%	56%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	480	487	505	491	498	512	501	516	460[10]

Notes:

1 The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the Study's safety objective (RR3) is unknown.

2 Long-term average annual percent of Newlands Project demand met.

3 Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

4 Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

5 Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

6 Assessment of financial conditions was not conducted for the Desired Reliability scenario. This scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

7 Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

8 Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

9 The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

10 Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:
Ag. = agricultural
Avg. = average
M&I = municipal and industrial
RR = risk rating
TAF = thousand acre-feet
TCID = Truckee Canal Irrigation District

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Comparison Based on Federal Planning Criteria

Table ES-7 compares the Study alternatives using the four P&G planning criteria: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability (WRC 1983).

Table ES-7. Summary of Alternatives Comparison Against Federal Planning Criteria

		600	350.a	350.b	350.d	250.a	250.b	250.d	Without-Action
Completeness		High	High	High	High	Medium-to-Low	High	High-to-Medium	Does not achieve Study objectives
Effectiveness		High	High	High	High	High-to-Medium	High	High	
Efficiency		High	High	Medium-to-Low	Medium	Medium	Medium-to-Low	Medium	
Accept-ability	M&I Users	High	High	Medium	Low	High	Medium	Low	Low
	Wetlands Users	High	High	Medium	High	Medium-to-Low	Medium	High	Low
	Agricultural Users	High	High	High-to-Medium	High	Medium-to-Low	High	Medium	Low
	Truckee River Environmental Users	Low	Medium-to-Low	Medium-to-Low	Medium	Medium	Medium	Medium	High

Key:
M&I = municipal and industrial

Scale

Lower Performance — Higher Performance

Findings and Future Actions

Findings regarding Study alternatives, other aspects of the Project, and potential future actions are described below.

Key Findings

The research and analysis conducted to support the planning process uncovered a number of other findings that are likely to be important considerations for additional studies related to the Project or to any alternative going forward. The Study's key findings are summarized as follows:

- **Canal Repairs are Possible to Address Safety Concerns** – The repair of the Truckee Canal such that it meets the Federal safety performance level (RR3) has been found technically possible in previous studies (see Chapter 1).

- **Project Water Demand Will Remain Steady –** While the complexion of the Project continues to change through ongoing water rights retirement and transfer programs, the fulfillment of these programs will not substantially diminish the potential volume of future water demand by Project water rights holders (see Chapter 3 and Appendix C).

- **Without Action, Canal Safety Issues Will Continue to Worsen –** A continuing significant need exists to implement actions to provide safety for the Truckee Canal. Without significant investments to improve the canal, its condition is expected to gradually worsen (see Chapter 3).

- **Action is Necessary to Preserve Water Supply Reliability –** Without addressing safety issues on the Truckee Canal, more stringent restrictions to canal conveyance capacities may gradually be implemented as the canal's condition worsens. These restrictions will significantly reduce the reliability of Project water supplies (see Chapter 2 and 3).

- **Alternatives Exist for Meeting Study Objectives –** Seven Study alternatives have been identified to satisfy the Study's objectives of safety and water supply, and are recommended for further development (see Chapter 5). The development of these alternatives revealed many constraints and potential opportunities for meeting the Study objectives, including:

  - **The Truckee Canal is Fundamental to the Project –** Plans that included either: (1) decommissioning the Truckee Canal and Derby Dam, or (2) allowing the canal conveyance capacity to be reduced over time to 150 cfs as a result of insufficient progress toward Reclamation safety requirements; were eliminated as viable alternative plans because the resulting conditions require far more extensive and expensive programs to support Project water rights than refurbishing the canal. For example, decommissioning the canal requires that between 50 percent and 80 percent of the Project's agricultural water rights would need to be retired permanently to meet the necessary level of reliability for the Project's remaining users, and cost 3- to 18-times as much as the cheapest alternative (see Chapter 4 and Appendix D3).

  - **Upstream Storage Looks Promising –** The use of upstream storage on the Truckee River for Project water was not evaluated, but appears very promising as an option for achieving the water supply objective. Allowing for Project credit water to be stored in Truckee River reservoirs may be a low-cost option for making flow stages below 600 cfs viable, but require substantial discussion with stakeholders to frame operational conditions (see Chapter 4 and Appendix D6).

   - **OCAP Limits Enhancements to Lahontan Reservoir Storage –** The regulations in OCAP that limit diversions from the Truckee River relative to storage targets in Lahontan Reservoir also limit the value of developing additional storage in Lahontan Reservoir. For example, a larger Lahontan Reservoir does capture more water during wet conditions but, because of OCAP storage target limitations, higher carry-over storages result in lower Truckee River diversions instead of higher water supply availability for the Project (see Chapter 4 and Appendix D7).

   - **Enhancing Carson River Inflows to Lahontan Reservoir Would Yield Marginal Benefit –** Acquisition of water rights from lower segments of the Carson River was considered because these would be the easiest to transfer to the Project; however, these rights are the least secure and provide little assistance during dry years, when additional supplies are needed most. The *Alpine* Decree prevents the secure transfer of rights from upper segments to Lahontan Reservoir, but even if it were possible, OCAP storage targets would reduce Truckee River diversions instead of improving Project supplies (see Appendix D5).

- **Study Alternatives Present Complex Tradeoffs –** Each of the alternatives is expected to appeal to different stakeholders and potential cost-share partners in different ways. Selection of any alternative for implementation would also require balancing tradeoffs among broader, related issues within the region. For example:

   - **Higher Truckee River Flows Have Highest Cost –** Alternatives that increase flows to Pyramid Lake also have the highest costs. Conversely, the alternative with the lowest cost results in the lowest flow to Pyramid Lake (see Chapter 5).

   - **Some Alternatives Reduce Ancillary Supplies –** Alternatives that reduce diversions from the Truckee River also reduce spills from Lahontan Reservoir, which reduces the overall supply for the Lahontan Valley wetlands. Likewise, alternatives that include efficiency improvements may reduce regional groundwater resources (see Chapter 5 and Appendix F).

- **Reclamation is a Required Partner –** The implementation of any alternative to improve safety of the Truckee Canal and serve Project water rights will require involvement of Reclamation, due to the Federal government's: interest in serving water rights of Project users; interest in serving water rights to Tribes and Stillwater NWR; interest in operations that affect habitat for listed or special status species at Pyramid Lake; and, ownership of facilities requiring rehabilitation, such as the Truckee Canal.

- **Implementation Requires Non-Federal Partners –** Benefits of alternatives affect more than one party, and include: public safety, water supply reliability, and the possibility of addressing other related regional issues. Further, it is uncertain whether any singular entity is capable of paying for the alternatives identified by the Study. Potential cost-share partners with Reclamation include:

  – **TCID** and the Project's water right holders, for their shared interest in maintaining Project water supply reliability;

  – **City of Fernley**, for their shared interest in improving the safety of the Truckee Canal along its corridor through the city; and

  – **Pyramid Lake Paiute Tribe**, for their potential interest in how various alternatives influence flows on the lower Truckee River and other related issues, such as endangered species recovery and recoupment.

Potential Next Steps for Implementing an Action

This Study identifies a range of alternatives for reducing risk from the Truckee Canal while providing for the reliable exercise of Project water rights in the future. Funding and legal authorization would need to be specified for any role that Reclamation plays in the implementation of a Study alternative. Depending on the project and the source of authorization, some level of environmental compliance review will also be required.

At this time, Reclamation does not have funding allocated for the implementation of Study alternatives. Additionally, it is likely that any funding made available for Reclamation participation or implementation of any Study alternative would require both cost-share partnership(s) and repayment for Federal participation.

Some Study alternatives could be implemented under existing Reclamation authorizations, while others would require a new congressional authorization. Specific features of Study alternatives affect the ability of Federal and non-Federal partners to fund, finance, and implement them. The sections below describe potential pathways for implementing the alternatives presented in this Study.

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Abbreviations and Acronyms

2008 Final Risk Assessment	Truckee Canal Issue Evaluation Report of Findings: Final Risk Assessment
2011 Report of Findings	Truckee Canal Issue Evaluation Report of Findings
AB	Assembly Bill
APS	allowance for procurement strategies
BIA	U.S. Department of the Interior, Bureau of Indian Affairs
BLM	U.S. Department of the Interior, Bureau of Land Management
CCP	comprehensive conservation plan
cfs	cubic foot per second
CWA	Clean Water Act
CWSD	Carson Water Subconservancy District
DEC Review	Design, Estimating and Construction Review
Derby Dam	Derby Diversion Dam
DOD	U.S. Department of Defense
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1966
GBLW	Great Basin Land and Water Trust
HDPE	High Density Polyethylene
I-80	Interstate 80
IDC	interest during construction
kV	kilovolt
kW	kilowatt
LCT	Lahontan cutthroat trout
LDPE	Low-Density Polyethylene
M&I	municipal and industrial
MAD	Maximum Allowable Diversion
mgd	million gallons per day
msl	mean sea level
MW	megawatt
MWh	megawatt hours
NAS	Naval Air Station
NDEP	Nevada Department of Environmental Protection
NDOW	Nevada Department of Wildlife
NED	national economic development

NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NTU	nephelometric turbidity units
NVCRIS	Nevada Cultural Resource Information System
NWR	National Wildlife Refuge
O&M	operations and maintenance
OCAP	Operating Criteria and Procedures for the Newlands Project
P&G	Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
PM10	particulate matter of 10 microns in aerometric diameter or less
ppm	parts per million
Project	Newlands Project
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RR	risk rating
SHPO	State Historic Preservation Office
STA	Truckee Canal station
Study	Newlands Project Planning Study
TAF	thousand acre-feet
TCID	Truckee-Carson Irrigation District
TDS	total dissolved solids
TMDL	total maximum daily load
TMWA	Truckee Meadows Water Authority
TMWRF	Truckee Meadows Water Reclamation Facility
TROA	Truckee River Operating Agreement
TTSA	Tahoe-Truckee Sanitation Agency
UAMPS	Utah Associated Municipal Power Systems
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USRS	U.S. Reclamation Service
WCWCD	Washoe County Water Conservation District
WQSA	Truckee River Water Quality Settlement Agreement

Chapter 1 Introduction

The Newlands Project Planning Study (Study) Special Report is a study conducted by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), to develop and evaluate alternatives for serving Newlands Project (Project) water rights reliably and safely. This report is authorized by the *Omnibus Appropriations Act of 2009* (Public Law 111-8, 123 Statute 609), which directed Reclamation to determine the actions necessary to rehabilitate the Truckee Canal so restrictions on its operation can be removed.

Since 1903, the Newlands Project has provided irrigation water to lands in the Lahontan Valley near Fallon, Nevada (the Carson Division), and to lands along the Truckee Canal near Fernley and Hazen, Nevada (the Truckee Division). Water for the Newlands Project is diverted from the Truckee River into the Truckee Canal at Derby Diversion Dam (Derby Dam), which is approximately 20 miles downstream from Reno, Nevada, and approximately 30 miles upstream from the river's terminus at Pyramid Lake. The Truckee Canal conveys Project water 32 miles east and south for irrigation in the Truckee Division and for delivery to Lahontan Reservoir, which also collects inflow from the Carson River and provides water supplies to the Carson Division. The Truckee Canal is the sole source of Project water within the Truckee Division, and has performed a critical role for the Carson Division by augmenting inflows from the Carson River and tempering the year-to-year variability in water supplies that might occur on the Carson River in isolation.

At approximately 4:16 a.m. on January 5, 2008, the Truckee Canal breached, resulting in the flooding of 590 properties in the City of Fernley. Canal operations were halted immediately until the breach was sealed and engineers had identified options for resuming operations safely. Although the damaged portion of the canal embankment was soon repaired, evaluations of the canal revealed a high potential for future failure. In response, Reclamation imposed restrictions on the water surface elevation allowed in the canal and the amount of water allowed to flow through the canal. The flow restrictions were reinforced by the Federal District Court for Nevada. If not lifted, these restrictions could complicate the long-term ability of Reclamation to provide Newlands Project water rights holders with reliable supplies.

The Newlands Project has experienced several changes over the past century that were unanticipated at its inception, including shifts in water uses and increased environmental requirements. In recent decades, many Truckee Division rights have been dedicated to the City of Fernley or sold out of the Project to augment inflows to Pyramid Lake. Within the Carson Division, a significant portion of water rights has been acquired for local wetland rehabilitation. In addition, the Project has also become an important component of regional energy development, and hydropower generation is now a central source of revenue to pay for Project costs.

Purpose, Scope, and Organization of Special Report

The Study's intent is to formulate, develop, and evaluate a range of alternatives to deliver water to Newlands Project water rights holders while also reducing risk to local communities from operating the Project's Truckee Canal. The purpose of this Special Report is to describe that process and present Study findings.

This Special Report presents a set of alternatives for meeting the Study's objectives; each alternative includes a set of repairs to restore a specified capacity for the Truckee Canal and one or more "measures" to ensure that Newlands Project water rights holders will continue to receive reliable water deliveries long term. The range of measures evaluated include securing alternative water sources for serving Project water rights holders, changing Project operations, or other actions that would improve supply or manage demand. To support evaluating a range of alternatives to provide water supply reliability for the Newlands Project, this report also documents the current and future water needs in the Project area, and potential accomplishments, costs, benefits, and environmental considerations of the alternatives developed.

Planning studies help identify and evaluate different ways to address a problem or issue in a manner that could be supported by decision makers, stakeholders, and Congress before funding more detailed studies or projects. Thus, the results of this Study may be used to inform decisions regarding the Newlands Project, including the extent of repairs to the Truckee Canal and its future operation; the report is informational only and is not intended to provide a specific recommended action. If Congress chooses to authorize and appropriate funds in the future for a feasibility study, construction, or other activities, this report would provide important context and guidance for undertaking those activities and any related environmental reviews.

This report contains seven chapters that summarize the work and findings from the Study, including the following after this introduction in Chapter 1:

Chapter 2 describes the plan formulation process, including Study objectives, planning conditions and constraints, and criteria used to help guide the Study and alternatives development.

Chapter 3 identifies current and likely future water resources and related conditions in the study area.

Chapter 4 summarizes the measures that may be combined to form alternatives and describes the development of preliminary alternatives.

Chapter 5 contains summaries of each final alternative, including features and accomplishments, as well as initial costs, benefits, and preliminary environmental considerations; describes related evaluation methods; and notes implementation considerations.

Chapter 6 compares the alternatives against the planning criteria; summarizes the alternatives comparisons and major findings; and suggests how this report may be used as a resource in the future.

Chapter 7 lists sources used to compile this report.

Study Authorization and Guidance

Congress provided Federal authorization for the Study in Public Law 111-8, 123 Statute 609, enacted in March 2009. This act authorized Reclamation to perform the Study and a risk analysis of the Truckee Canal, as follows:

> *Lahontan Basin Project, Nevada – Within the funds provided, $2,500,000 is to perform an exploration/risk analysis of the Canal, which breached in January 2008 flooding Fernley, Nevada. The analysis will determine the full extent of rehabilitation needed for the canal to resume flows above 350 cubic feet per second.*

As the authorization requires, Reclamation has already conducted a number of studies to determine the extent of the risk associated with operating the Truckee Canal, and to investigate possibilities to rehabilitate the structure or take other corrective actions to reduce this risk at a range of different canal capacities, including 600 cfs, 350 cfs, 250 cfs, and 0 cfs. This Study is a companion effort to that work and will use the range of canal rehabilitation options Reclamation has already identified as building blocks for formulating Study alternatives to achieve a desired level of reliability for the Newlands Project. A review of the engineering studies Reclamation has already conducted appears in this chapter, and a discussion of how the related information and conclusions fit into this Study's planning process appears in Chapter 2, "Plan Formulation Process," and Chapter 4, "Measures and Preliminary Alternatives."

In contrast to some Federal planning studies, the intent of this Study is not necessarily to culminate in actions by the Federal government. The future of the Truckee Canal is of interest to a diverse set of agencies and stakeholders, and the alternatives formulated and evaluated in the Study may include elements that could call for participation by a broad range of partners.

Other guidance for the Study's alternatives formulation process includes the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (WRC 1983). Although the P&G provide a valuable framework for development, evaluation, and comparison of alternatives that are feasible for Federal action, strict adherence may preclude the consideration of actions that are not federally feasible but are otherwise feasible and preferable for local or regional actions; thus, the P&G is used as general planning guidance only, and strict adherence is not appropriate for this type of study.

Study Area

The primary study area for this investigation consists of the Newlands Project boundaries, Truckee-Carson Irrigation District (TCID) service area in the Newlands Project, Churchill County, the City of Fernley in northern Lyon County, the Fallon Paiute-Shoshone Indian Reservation, the Stillwater National Wildlife Refuge (NWR), and the Carson Lake and Pasture, as shown in Figure 1-1. Most of the primary study area is in Churchill County, Nevada, among Lahontan Reservoir, Stillwater NWR, and Carson Lake and Pasture. The remaining portion of the primary study area is in Lyon, Washoe, and Storey counties around the Truckee River below Derby Dam, and surrounding Fernley, the Truckee Canal, and Lahontan Reservoir. A portion of the Truckee Canal near Wadsworth crosses the southernmost portion of the Pyramid Lake Indian Reservation.

Although the primary study area encompasses the lands and facilities of the Newlands Project, some alternatives may involve lands, users, and political entities outside the primary study area boundaries. Thus, the extended study area is considered to encompass the broader Carson River watershed, Truckee River watershed, and Dixie Valley. These areas encompass Lake Tahoe, Pyramid Lake, a number of cities and communities, as well as the majority of the Pyramid Lake Indian Reservation. For the sake of brevity, this report occasionally uses the general term "study area(s)" in titles and headings to broadly refer to both study areas.

These geographic areas are described in greater detail in Chapter 3, "Study Area Conditions."

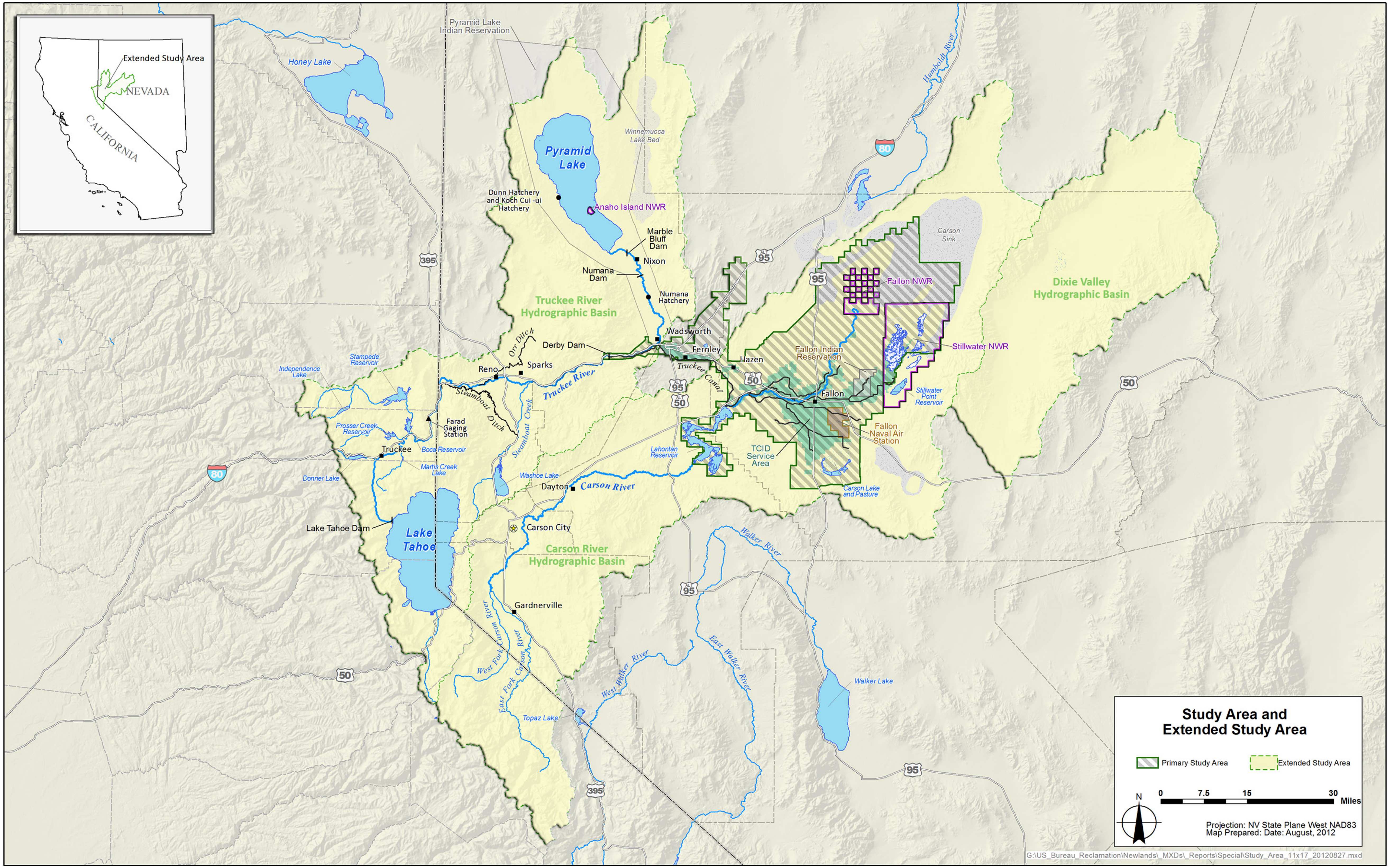

Figure 1-1. Study Areas for the Newlands Project Planning Study

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Background

The Newlands Project is one of Reclamation's first irrigation projects and nearly as old as the agency itself. Reclamation began the Project in 1903 to provide irrigation water to the Lahontan Valley, near Fallon, Nevada, and to lands in the Truckee Basin near Fernley, Nevada. These areas of the Project are known as the Carson Division and Truckee Division, respectively.

The Newlands Project covers lands in the west-central Nevada counties of Churchill, Lyon, Storey, and Washoe. Currently, Project facilities consist of two reservoirs (Lake Tahoe and Lahontan), three storage dams (Tahoe, Lahontan, and Sheckler), two diversion dams (Derby and Carson), one hydroelectric power plant, and hundreds of miles of canals and laterals, along with numerous checks and other hydraulic features throughout. Reclamation owns the principal Project facilities, but two additional power-generation structures were financed locally and are owned by the Project's local operator, TCID.

Project water comes from the Carson River and also from the Truckee River. The Carson Division is served by both rivers, while the Truckee Division is entirely served by the Truckee River. Lahontan Dam collects inflow from the Carson River to be used by the Carson Division. Derby Dam, located on the Truckee River approximately 20 miles downstream from Reno, diverts water into the Truckee Canal to serve the Truckee Division. If the projected supply at Lahontan Reservoir is unlikely to meet the needs of water rights holders in the Carson Division, the Truckee Canal also delivers water to the reservoir for use by the Carson Division. The Carson River and Truckee River terminate in the Carson Sink and Pyramid Lake, respectively.

Uses of Project Water

Currently, the Project delivers water to about 57,000 acres of actively irrigated agricultural land – 2,000 acres and 55,000 in the Truckee and Carson divisions, respectively – with alfalfa as the region's primary crop. Average annual rainfall in the area is approximately 5 inches, which is considerably less than the average annual evaporation of 4 feet, and local farmers rely heavily on Project water for irrigation.

In addition to irrigation, the Project serves water rights for wetlands at the Stillwater NWR, Carson Lake and Pasture, and the Fallon Paiute-Shoshone Indian Reservation. Drainage from Project canals also serves as a source of water for wetlands, and in years with wet hydrological conditions, excess flows spilled or released from Lahontan Dam reach Stillwater NWR and Carson Lake and Pasture. The Project is also authorized for municipal and industrial (M&I) use, although has not yet delivered for this purpose. The Project only supplies surface water, although agriculture and Project operations support incidental groundwater recharge in the basins.

While hydropower generation is not a consumptive use of Project water, it is an important component of operations and supports the Project financially, contributing around one-third of TCID's operating revenue (Reclamation 2005). TCID has built transmission lines to convey power generated by facilities at Lahontan Dam to the communities of Fallon, Fernley, Wadsworth, Hazen, and Stillwater; the Fallon Reservation and Colony; and most of the less-populated areas of the Project (Reclamation 2011f). However, these customers are served by Sierra Pacific Power Company (now known as NV Energy), with whom TCID has a long-term lease for power distribution (NV Energy 1999). TCID also has a second lease with Utah Associated Municipal Power Systems (UAMPS) for power produced at the 26-Foot Drop Powerplant. UAMPS is responsible for integrating electrical resources for the City of Fernley. The lease term initially began in 2005 and extends through 2014.

Operations

In 1926, Reclamation contractually turned the Project over to TCID for operations and maintenance (O&M). Members in the district own their water rights individually, which is one of the Newlands Project's distinguishing characteristics relative to other Reclamation projects in the West.

The original contract between Reclamation and TCID was terminated in 1984. Temporary contracts were used until 1996, when a new contract was signed. Under the contract with Reclamation, TCID management has the fiduciary responsibility to operate and maintain the Newlands Project's facilities without cost to the Federal government. O&M fees and assessments charged to water users are the source of revenue to cover the district's expected expenses and to maintain reserves for contingencies.

Use of the Term "Flow Stage" in this Report: The capacity restrictions placed on the Truckee Canal are often expressed in terms of a flow rate (e.g., 350 cubic feet per second, or cfs). These capacity restrictions, however, are actually based on the assumed water surface elevation, or stage, in the canal at a given flow rate. Changing conditions in the canal, such as growth of the invasive aquatic weed milfoil, will change the flow-stage relationship such that lower flows are possible at the previously specified stage restrictions. However, the stage restrictions identified will not be altered to allow for the flow rates that were previously possible without milfoil. For clarity and accuracy, this report uses the term "flow stage" in conjunction with the expression of cfs to emphasize that the flow rate restrictions being discussed for the Truckee Canal are also based on the elevation of the water in the canal. Further information about flow stages is found in Appendix A, "Flow-Stage Relationships for the Truckee Canal."

Several regulatory requirements and agreements also affect operation of the Newlands Project, including the Truckee River Agreement, *Orr Ditch* Decree, *Alpine* Decree, Operating Criteria and Procedures for the Newlands Project (OCAP), and water rights settlement acts. Many of these and their implications will be described in greater detail later in this chapter and elsewhere in this Special Report.

Truckee Canal Breach

In the early morning of January 5, 2008, a 50-foot portion of the Truckee Canal embankment failed about 12 miles downstream from Derby Dam, releasing water that inundated a residential development in the City of Fernley, flooding 590 properties. No fatalities occurred, but more than $1 billion in tort claims were filed against the Federal government, local governments, and TCID, and have now been consolidated into class-action lawsuits.

As a result of the incident, Reclamation and TCID temporarily halted canal operations. Inspections revealed numerous stability issues, such as rodent burrows, vegetation, and other problems, along many areas of the canal embankment. Based on these findings and concerns about the canal's immediate and long-term structural integrity, water elevations within the canal are currently restricted to elevations corresponding to unchecked flows (flow stages) of 350 cubic feet per second (cfs) (see sidebar). This is significantly less than the canal's more recent maximum operating capacity of 900 cfs, and may result in Carson Division water rights holders experiencing increasing shortages in service of their water rights.

Related Studies and Programs in the Study Area

This section of the Special Report provides context for the Study and identifies previously developed information that provided inputs to the planning process. Given the Newlands Project's long history in the Federal Reclamation program and the decades of intense conflict surrounding management of northern Nevada's rivers and lakes, a multitude of entities are now involved in studying or managing resources in the study area. Additionally, legal arrangements, negotiated settlements, and other documents also shape the Project's current form and function.

Projects and Programs

Numerous activities of various Federal, State, and local agencies and organizations in the study area are pertinent or related to the Newlands Project and this Study. Such projects and programs are listed alphabetically and described below. Parenthetical notes identify the lead and/or supporting agencies or organizations for each.

Carson Lake and Pasture (NDOW, Reclamation)

Since the 1990s, the Nevada Department of Wildlife (NDOW) has purchased Newlands Project water rights for delivery to Carson Lake and Pasture – approximately 10,800 acres of wetlands that Reclamation is in the process of transferring to NDOW. NDOW holds water rights for the property and manages it cooperatively with Greenhead Hunting Club through TCID's Carson Lake Pasture Advisory Committee (Lahontan Audubon Society 2001).

Donner Lake (TMWA, TCID)

Truckee Meadows Water Authority (TMWA), the municipal water provider in the Reno-Sparks area, and TCID jointly hold rights for up to 9,500 acre-feet of water stored at Donner Lake (Reclamation 2011f).

Conveying this water for Project use through Federal facilities, such as the Truckee Canal, requires TCID to obtain a Warren Act contract with Reclamation. Under certain conditions, Public Law 101-618 authorizes the use of private water, such as from Donner Lake, to supply Lahontan Valley wetlands without a Warren Act contract. However, this would likely require an agreement among Reclamation, TCID, and U.S. Fish and Wildlife Service (USFWS); deliveries through the Truckee Canal would still be subject to OCAP limits; and USFWS would need to obtain some manner of ownership or control of the water for wetlands use, and would also need to assume costs of delivery.

NAS Fallon (U.S. Navy)

The U.S. Department of Defense (DOD) maintains a large presence throughout Nevada; the Navy is one of the largest employers within the study area and also benefits from Newlands Project water.

Naval Air Station (NAS) Fallon is located within the boundaries of the Newlands Project southeast of Fallon, north of Carson Lake and Pasture. It began as an Army Air Corps airstrip established in the early days of World War II to launch missions against Japan if a strike against the West Coast occurred. It now serves as a comprehensive tactical warfare training center (CNIC 2011). NAS Fallon holds Newlands Project water rights that are used to irrigate crops in an agricultural buffer zone surrounding the facility and also to benefit Lahontan Valley wetlands.

Newlands Project (Reclamation, TCID)

The Newlands Project provides water for irrigation in the Lahontan Valley in northwest Nevada. Construction began in 1903 for the Truckee Canal and Derby Dam, some of the primary water supply features of the Newlands Project. Other facilities built as part of the Newlands Project include Lahontan Dam, Lahontan Powerplant, Carson Diversion Dam and canals, laterals, and drains for irrigation deliveries to around 55,000 acres annually (see Appendix C, "Projected Future Water Rights and Demands for the Newlands Project"). Lake Tahoe Dam, which controls releases from the lake into the Truckee River, is also considered a facility of the Newlands Project.

Since January 1, 1927, TCID has operated and maintained the Newlands Project under contract with Reclamation.

The Newlands Project contains two divisions:

- Truckee Division lands are primarily in and around Fernley, Nevada, a growing city in Lyon County about 30 miles east of Reno. The division also includes the Hazen and Swingle Bench areas in Churchill County. The Truckee Division contains less than 5 percent of the Project's total acreage, and is supplied exclusively by water diverted at Derby Dam from the Truckee River into the Truckee Canal.

- The Carson Division contains the bulk of Project lands, in and around the City of Fallon, Nevada, about 65 miles east of Reno. Water users of the Carson Division include farmers, the Fallon Paiute-Shoshone Tribe, the Stillwater NWR, and other wetlands. Irrigation water for the division is released from Lahontan Reservoir, located on the Carson River and at the terminus of the Truckee Canal.

Although the Newlands Project's reliance on Truckee River supplies has declined with the enactment of several operational requirements and implementation of various efficiency measures, the Truckee Canal continues to play a significant role in supplying Project water. The Truckee Division receives 100 percent of its water supplies from the Truckee Canal. Before the 2008 Truckee Canal breach, the Carson Division received a long-term average of 25 percent of its water supplies from the Truckee Canal; however, in some of the driest years, the Carson Division received as much as 75 percent of its supplies from Truckee River diversions.

Newlands Project Water Rights Retirement Programs (CWSD, GBLW)

Two programs have been established to resolve administrative and judicial disputes brought by the Pyramid Lake Paiute Tribe involving 9,429 water-righted acres in the Newlands Project by acquiring and permanently retiring water rights associated with 6,500 Project acres.

- **AB 380 Program (CWSD) –** From 2000 to 2006, the Carson Water Subconservancy District (CWSD) administered the first Newlands Project Water Rights Retirement Fund and purchasing program established by passage of Nevada's Assembly Bill (AB) 380 in 1998. The program was successful in purchasing and retiring 4,623.54 acres and their appurtenant water rights in the Truckee and Carson divisions from willing sellers (CWSD 2001, Reclamation 2010). The purchases were funded by Reclamation ($6.087 million), State of Nevada ($3.3 million), Truckee Meadows Water Authority and Sierra Pacific Power Company ($3.44 million), and Carson-Truckee Water Conservation District ($100,000) (Reclamation 2010). Although the AB 380 program expired on June 30, 2006, its goals continue through the Water Rights Compensation Program.

- **Water Rights Compensation Program (GBLW) –** Once the AB 380 program expired, Congress established a new Newlands Project Water Rights Fund to acquire the remaining water rights necessary to meet the 6,500-acre retirement target. Reclamation, the Pyramid Lake Paiute Tribe, and the State of Nevada are the three parties to the program and fund, which are administered by Great Basin Land and Water (GBLW). Congress has directed Reclamation to contribute $10 million to a fund supporting this program and Newlands Project water rights retirement programs in the future (Reclamation 2010). As of June 2012, 66 acres have been acquired by the program.

Stillwater NWR (USFWS)

Northeast of Fallon in the Lahontan Valley, USFWS manages 77,000 acres of land as Stillwater NWR. The refuge was established in 1949 and is part of the Stillwater NWR Complex. USFWS manages the wetlands to approximate the area's natural biological diversity to benefit breeding and migrating waterfowl, shorebirds, and other water birds and wintering waterfowl (USFWS 2002). Currently, USFWS is the single largest user of Newlands Project water, for the purposes of managing the refuge's wetlands.

Truckee Storage Project (Reclamation, WCWCD)

The Truckee Storage Project includes Boca Dam and Reservoir, located near the mouth of the Little Truckee River downstream from Stampede Dam in California. The project was constructed in 1939 and has the capacity to store up to 40,850 acre-feet. It provides a supplemental water source for approximately 29,000 acres of farmland in the Truckee Meadows area surrounding Reno and Sparks, Nevada. Boca Reservoir is operated in conjunction with Lake Tahoe Dam to regulate Truckee River flows to meet the needs of downstream users of Truckee River water, such as Truckee Meadows users (including Reno-Sparks and irrigators), the Newlands Project, and the Pyramid Lake Indian Reservation. The Washoe County Water Conservation District (WCWCD) operates and maintains Boca Dam under contract with Reclamation (Reclamation 2011g).

Washoe Project (Reclamation, USFWS)

The Washoe Project, authorized in 1956, includes Stampede Dam, Reservoir, and Power Plant on the Little Truckee River; Prosser Creek Dam and Reservoir; Marble Bluff Dam; and Pyramid Lake Fishway. Stampede and Prosser Creek dams conserve runoff and regulate flow into the Truckee River. The project is used for flood protection, fish and wildlife benefits, M&I purposes, and recreation. (Reclamation 2011h). All of the project's facilities are located in California and are operated by Reclamation, except for Pyramid Lake Fishway and Marble Bluff Dam, which are located on the Truckee River in Nevada and operated by USFWS. Since 1983, Stampede Reservoir has also been dedicated to storing water for the benefit of fisheries along the Truckee River and at Pyramid Lake (Reclamation 2011h). Since 1994, TMWA has had the opportunity to store water in Stampede Reservoir through an interim storage contract with Reclamation for up to 14,000 acre-feet. OCAP contains a provision that allows for storing Newlands Project Credit Water in Stampede Reservoir under certain conditions.

Original plans for the project included additional facilities, including Watasheamu Dam and Reservoir on the east fork of the upper Carson River, to develop and deliver supplemental water to irrigators for nearly 44,000 acres above Lahontan Dam (Reclamation 1991). The *Fallon Paiute Shoshone Tribal Settlement Act of 1990* and *Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990* (Public Law 101-618) revoked the authorization to construct these facilities (Reclamation 2011h).

Water Rights Acquisition Program for Lahontan Valley Wetlands (USFWS, BIA, State of Nevada)

USFWS conducts a water rights acquisition program for the Stillwater NWR and other designated Lahontan Valley wetland areas. The program was initiated with the passage of Public Law 101-618. Specifically, Subsection 206(a) of Public Law 101-618 directs the Secretary of the Interior to acquire enough water and water rights, in conjunction with the State of Nevada and other parties, to sustain a long-term average of 25,000 acres of primary wetland habitat in the Lahontan Valley at Stillwater NWR, Carson Lake and Pasture, and the Fallon Paiute-Shoshone Indian Reservation wetlands (USFWS 1996a).

The goal of the program is to acquire enough water to provide the wetlands with approximately 125,000 acre-feet annually – the estimated amount needed to support 25,000 acres of wetland habitat – by using irrigation drain water and releases from Lahontan Reservoir, acquiring 75,000 acre-feet of Carson Division water rights, acquiring middle Carson River water rights, leasing Carson Division water rights, obtaining water conserved at NAS Fallon, and pumping groundwater (USFWS 1996a). The program is a “willing-seller” purchasing program; water-righted land is only purchased from sellers who approach USFWS to initiate a sale.

As of December 2012, more than 43,200 acre-feet of water rights in the Carson Division had been acquired for Lahontan Valley wetlands, including 32,500 acre-feet by USFWS, 8,900 acre-feet by the State of Nevada and the Nevada Waterfowl Association, and 1,800 acre-feet by the U.S. Bureau of Indian Affairs. In addition, USFWS receives about 3,700 acre-feet of treated effluent from NAS Fallon, Churchill County and the City of Fallon (Richard Grimes, USFWS, personal communication, December 21, 2012).

Water Rights Conservation Program/Water Quality Settlement Agreement (GBLW, Reno, Sparks, Washoe County)

The Truckee River Water Quality Settlement Agreement (WQSA) signed in 1996 by Reno, Sparks, Washoe County, U.S. Department of the Interior, U.S. Department of Justice, U.S. Environmental Protection Agency, Nevada Department of Conservation and Natural Resources, and the Pyramid Lake

Paiute Tribe established a Truckee River water rights purchasing program and fund administered by GBLW (Reclamation et al. 2008).

Under the program, GBLW, on behalf of the Pyramid Lake Paiute Tribe, has purchased about 4,400 acre-feet of water rights from the Truckee River and in the Truckee Division of the Newlands Project (GBLW 2011). These purchased rights remain as Truckee River flows to improve the quantity and quality of water at Pyramid Lake. Congress has directed Reclamation to contribute $10 million to a fund supporting this program and Newlands Project water rights retirement programs in the future (Reclamation 2010).

Previous Studies and Reports

Among the sources the Study used to inform the planning process are many Federal documents and local reports, all described and summarized below. This list is not exhaustive, and the set of additional documents consulted in detail appear in Chapter 7, “References.” The information is organized alphabetically by agency name, and the year each report or Study was produced is shown in parentheses.

Churchill County

In recognition of community growth and the changing nature of the availability of Newlands Project water, Churchill County has been investigating a range of options that might be available to meet the community’s demand for water in future years.

Churchill County Water Resources Plan (2003) This plan investigated sources to meet community needs through 2025 and 2050 (Churchill County 2003). Those sources include local groundwater resources in Lahontan Valley and groundwater in nearby Dixie Valley. For each of the sources identified, the plan described the type of treatment required to make the water suitable for use by the community, as well as any associated costs. Capital costs ranged from $120.09 million (Historic Lahontan Valley Groundwater) to $236.07 million (Recharge, Storage, and Recovery); annual O&M costs ranged from $10.84 million (Lahontan Reservoir) to $15.57 million (Recharge, Storage, and Recovery).

The county circulated the draft plan among dozens of public agencies and groups for review, and these reviewers rated the above alternatives as follows from “most favorable” to “least favorable”: Dixie Valley; Lahontan Reservoir; Recharge, Storage, and Recovery; Conjunctive Use; Induction Wells; and Historical Lahontan Valley Groundwater. Ultimately, the plan recommended continuing to use historical groundwater; obtaining additional supplies through water rights required for new municipal development; and continuing to investigate the feasibility of the alternatives above (Churchill County 2000).

City of Fernley

The City of Fernley has grown through the transition of agricultural lands into residential developments. With these transitions, the underlying water rights have been dedicated to the City of Fernley, which manages the rights for service to the development. The City currently does not receive surface water deliveries from the Truckee Canal, but relies on pumping and treating local groundwater supplies that are dependent on incidental seepage from the Truckee Canal. The City has only recently exercised its surface water rights by leasing them to the Pyramid Lake Paiute Tribe to remain as instream Truckee River flows, but has not exercised them for direct use within Fernley. Under a 2009 settlement agreement among the City of Fernley, the Pyramid Lake Paiute Tribe, U.S. Department of Justice, and Reclamation, Fernley would need to satisfy a number of permitting and other requirements to exercise its surface water rights using Federal facilities such as the Truckee Canal.

During the late 1990s and early 2000s, Fernley experienced a period of rapid urban growth, but this growth rate has since receded to pre-1990 levels. Responding to that period of growth, and the following recession, has created several infrastructure planning and financing challenges for the City. The City is revisiting long-term growth projections and related water infrastructure plans.

Water Master Plan (2008) In 2006, the City of Fernley served approximately 7,000 customers and was experiencing maximum demands of approximately 10 million gallons per day (mgd); the city anticipates a need for 30 mgd of water treatment capacity by 2025 (City of Fernley 2008a). The plan noted that, while the water supply infrastructure was in fair condition, production and storage capacity were challenged in meeting peak daily demands. The plan proposed $64 million in capital improvements, nearly half of which would develop additional groundwater pumping capacity, and a third of which would be used to upgrade the existing treatment plant to accept surface water supplies.

Reclamation

As the owner of the Newlands Project, Reclamation has studied the Project's operations and facilities extensively. A number of recent reports also focus on problems with the Truckee Canal and how to address the public safety risks it poses.

Newlands Project Efficiency Study (1994) At the direction of Public Law 101-618, Reclamation undertook a study to investigate the feasibility of improving the Newlands Project's conveyance efficiency to an average level of 75 percent or greater by 2002.

Reclamation evaluated current and potential performance and reported on various groups of measures, including efficiency measures (metering, canal lining, reservoir diking, reuse, land acquisition, and automation), diversion reductions (land retirement, recoupment, other users on the Truckee and Carson rivers), and measures identified or pursued by other programs (USFWS Water

Conservation Plan and Water Rights Acquisition Program, and measures suggested by the 1988 OCAP). The study also addressed the likely effects of efficiency measures on local groundwater conditions and wetlands in the Carson River Basin.

Following the independent discussion and review of each individual measure, the most cost-effective measures were assembled into two alternatives: a least-cost alternative (estimated cost of $63 million in 1994 dollars) and a structural alternative (estimated cost of $127 million in 1994 dollars). Both alternatives achieved 75 percent Project efficiency. Funding for the two alternatives was identified as a challenge, and neither alternative was implemented.

In addition to authorizing the *Newlands Project Efficiency Study* (Reclamation 1994), Public Law 101-618 included central elements intended to promote enhancement and recovery of endangered and threatened fish species at Pyramid Lake; protect the health of wetlands in the Lahontan Valley; encourage solutions for competition over Truckee River water; enact settlements for the Fallon Paiute-Shoshone and Pyramid Lake Paiute Tribe over water-related issues; and settle California-Nevada interstate water apportionment.

Newlands Project Economic Viability Study (2005) Increasing urbanization and demand for water for environmental uses have resulted in a decrease in agricultural land uses within the Newlands Project. The changes in land and water use impact TCID's operations and the water supply available to support agriculture and hydropower production. As more land and water are converted to nonagricultural uses, there is concern that the revenue required to maintain service to the land remaining in production will exceed the ability to pay for some farm types and diminish the ability of TCID to meet O&M maintenance obligations. To address these concerns, Reclamation completed an economic/financial analysis to assess the viability of the Newlands Project under a variety of water supply and water transfer scenarios (Reclamation 2005). The analysis applied three economic models to determine district viability and a fourth model to estimate regional effects from changes in land and water use:

- **Agricultural Production Model –** A representative farm-based optimization model was developed to estimate changes in farm-level payment capacity with changes in agricultural water supplies. The representative farms were selected to represent the variety of farm types within the Newlands Project. Noncommercial agriculture ("hobby farms") was excluded from consideration in the model.

- **Hydropower Production Model –** Changes in water supply under the scenarios were used to estimate changes in hydropower production and revenues at district-owned facilities.

- **District Financial Model –** TCID financial statements were used to develop a financial model to determine ability to pay at the district level. Ability to pay was defined as the financial capability of the district to meet Reclamation repayment obligations. Output from the Agricultural Production Model and Hydropower Production Model provided key inputs to the financial model.

The study considered nine scenarios with varying assumptions regarding water supply reliability and volume of water transfers from agriculture to alternative uses. Estimated district-level ability to pay ranged from minus (-) $4.6 million to $2.5 million annually. The two "combination" alternatives that considered both changes in water supply reliability and water transfers to alternative uses estimated district-level ability to pay between $657,000 and $892,000 annually.

Special Technical Embankment Examination (2008) Following the breach of the Truckee Canal in 2008, the canal was taken out of operation and Reclamation initiated several studies, including: a detailed inspection of the canal to describe its condition (Special Technical Embankment Examination, Reclamation 2008a), an independent forensic review of the factors likely leading to the breach (Investigative Evaluation Report, Reclamation 2008b), and a risk assessment (*Truckee Canal Issue Evaluation Report of Findings: Final Risk Assessment* (2008 Final Risk Assessment), Reclamation 2008c).

The findings of the embankment examination were released in January 2008 and reported evidence of high rodent activity as well as a large number of trees and other woody vegetation growing on or near the canal embankment. Both rodent activities and vegetation can promote seepage paths through the embankment. While the investigation did not identify specific locations where obvious and immediate failures would occur if canal operations were allowed to resume, the quantity of issues that posed a potential for future failure was described as "high," and Reclamation recommended that flows in the canal be restricted until a prioritized list of repairs could be made and implemented.

Truckee Canal Failure on 5 January 2008: Investigative Evaluation Report (2008) The Investigative Evaluation Report summarized the findings of the independent forensic examination of the factors most likely leading to the canal breach (Reclamation 2008b). The report included geological surveys, assessments of historical performance, interviews with TCID and Reclamation staff, hydrologic analyses, and descriptions of a range of potential failure modes (such as failure caused by internal erosive forces, seismicity, and sabotage).

The Investigative Evaluation Report concluded that the most likely cause was piping triggered by the combination of high ramping rates and water flow on January 4 and January 5, and the presence of animal burrows that provided seepage paths through the embankment; together, these conditions promoted embankment erosion that resulted in a breach.

Truckee Canal Issue Evaluation Report of Findings: Final Risk Assessment (2008) The Reclamation risk analysis considered the likelihood of another canal breach at various flow levels. The 2008 Final Risk Assessment (Reclamation 2008c) describes several actions for resuming flows in the Truckee Canal and for assessing the short- and long-term actions needed (including repairs and changes to O&M procedures) to allow the canal to safely resume operations. Operations were considered at a variety of flow levels between zero and full reinstatement of the canal.

The assessment's main conclusions included:

- Recommendation for restricting flow in the urbanized portions of the Truckee Canal (near Fernley) to elevations that correspond to a flow-stage of 150 cfs. The report also provided several recommendations for structural and operational fixes that would be needed to increase canal flows to 150 cfs, including installation of a temporary lining along the bottom and north bank of the canal, through urbanized portions of the canal.

- Recommendation for further study of the risks posed by various flow levels for describing the long-term requirements for resuming flows through the entire length of the canal.

Truckee Canal Issue Evaluation: Design, Cost Estimating, and Construction Review (2008) Reclamation conducted a Design, Estimating and Construction Review (DEC Review), which included a review of recent reports, findings, and recommendations as well as a field investigation by senior Reclamation staff (Reclamation 2008d).

The DEC Review broadly agreed with most of the findings and recommendations made in the previous Reclamation reports. However, the review suggested that a flow restriction of 150 cfs was overly conservative for short-term operations and that short-term requirements for bringing the canal into service should be limited to operational limitations on flow, response planning, increased monitoring, and other procedural measures. The DEC Review suggested that limiting interim (1 to 5 years) canal flows to a flow-stage of 350 cfs should provide appropriate short-term operational constraints for risk reduction on the Truckee Canal, commensurate with the identified risk for canal failure.

At the recommendation of the DEC Review, Reclamation's Regional Engineer set short-term flow restrictions through the urbanized portions of the canal to elevations corresponding to an unchecked flow of 350 cfs.

Truckee Canal Permanent Repair Special Study (2009) At the recommendation of the 2008 Final Risk Assessment and DEC Review, Reclamation developed cost estimates for a range of permanent repair alternatives for the Truckee Canal (Reclamation 2009b). These evaluations, which were funded by the passage of Public Law 111-8, were structured around three different canal capacities or operations. Each evaluation reported on expectations for total cost (including field, design, contingency and indirect costs):

- Estimating the costs to restore Truckee Canal flows within the City of Fernley (Fernley Reach) to safely convey a flow stage of 500 cfs. The estimated cost was $65.5 million.

- Estimating the costs to restore Truckee Canal flows to safely convey a flow stage of 500 cfs for the entire length of the canal. The estimated cost was $89.6 million.

Separate estimates of water supply reliability were assembled for each proposal considered under a third investigation described below.

- Evaluating additional ways of delivering water to the Carson Division without using the Truckee Canal or water from the Truckee River. The following measures were considered in combination with abandoning the Truckee Canal:

  - Raise Lahontan Dam to capture additional inflow from the Carson River. The estimated cost was $155 million. Increased storage at Lahontan Reservoir was found to be incapable of replacing water supply reliability from the Truckee Canal, and this alternative would need to be combined with other measures to be successful. It was noted that this program would reduce incidental spills, which currently benefit the Stillwater NWR.

  - Install a groundwater pumping system and conveyance piping. The estimated cost was $200 million. The study noted that the most optimistic estimates for water supply available from Dixie Valley groundwater imports were less than half of the volume required to replace the water supply reliability of the Truckee Canal, and this alternative would need to be combined with other measures to be successful.

  - Improve the efficiency of the Carson Division canal system. The estimated cost was between $45.2 and $128 million. The study noted that the benefits of increasing efficiency would not replace the water supply reliability of the Truckee Canal, and this alternative would need to be combined with other measures to be successful.

  - Retire water rights from the Carson Division to decrease the irrigation needs to existing supply from Lahontan Reservoir. The estimated cost for this was $100 million. The study noted that this alternative would require retiring over 40 percent of the current irrigated lands in the Newlands Project, and that the feasibility of retiring that much land was questionable.

– Implement water conservation improvements in the Carson Division to decrease the irrigation needs to existing supply from Lahontan Reservoir. No costs were developed for this proposal because the estimated water supply reliability for the alternative, compared with other alternatives, was judged to be insufficient.

Truckee Canal Issue Evaluation Report of Findings (2011) At the recommendation of the 2008 Final Risk Assessment and DEC Review, Reclamation developed a series of updated risk assessments for the three reaches of the Truckee Canal (Derby, Fernley, and Lahontan reaches) at water surface elevations corresponding to canal flows of 250, 350, and 600 cfs. The findings of these evaluations (Reclamation 2011a, b, c) are summarized in the April 2011 document, *Truckee Canal Issue Evaluation Report of Findings: Summary of Final Baseline Risk Estimates and Evaluation of Risk Reduction for Proposed Corrective Action Alternatives* (2011 Report of Findings) (Reclamation 2011d).

The 2011 Report of Findings summarized baseline risks for operating the Truckee Canal, and identified measures for reducing various risks to an acceptable level. Risks to the canal were categorized by failure mode (the general descriptors for the manner in which canal failures occur). The report described alternatives for responding to the following failure modes: static internal erosion failures, ice and debris jam failures, hydrologic overtopping failures, liquefaction failures, and seismic failures.

Three potential designs were described for reducing the risk of internal erosion failure: a low-density polyethylene geomembrane/concrete lining within the canal prism, a cement-bentonite cutoff wall within the canal embankment, or a high-density polyethylene cutoff wall within the canal embankment. The report noted that the required extent of internal erosion protection depended upon the desired level of risk, but could include modifications of the entire 12 miles of the Fernley Reach, 4 miles in the Lahontan Reach and 2 miles in the Derby Reach.

Designs for reducing the risk of ice and debris jam failures, and hydrologic overtopping failures included cross drainage structures in the Derby Reach, new check structures and wasteways in the Fernley Reach, adding a new check structure at the beginning of the Fernley Reach, and raising the canal banks in the Lahontan Reach.

Only one 200-foot section of the Truckee Canal, in the Lahontan Reach near turnout TC-12, was found to require excavation and recompaction to reduce the risk of liquefaction failure.

The report evaluated seismic risks at 10,000- and 1,000-year return frequencies and concluded that structural alternatives to reduce seismicity risks were not likely to be economically feasible; however, prudent actions, such as the construction of wasteways and check structures at strategic locations to divert or control flows upstream from a seismic breach, could mitigate the risk and would likely save lives in the event of an earthquake. The report noted that actions considered for internal erosion failures would also reduce risks for more frequent (1,000-year) seismic risks.

Corrective Action Study Alternatives and Appraisal Level Cost Estimates (2011) Parallel with the development of the 2011 Report of Findings, Reclamation formulated specific alternatives for mitigating the risks of operating the Truckee Canal (Reclamation 2011e). Designs were assembled for a matrix of options defined by three categories of functionality: canal section, reach capacity, and risk reduction achieved. Canal sections included the Derby, Fernley, and Lahontan reaches. Reach capacities included water surface elevations corresponding to canal flows of 250, 350, and 600 cfs, respectively. Risk reduction achieved was categorized by three risk rating (RR) levels:

- **Risk Rating 1 (RR1) –** "Long-Term Risk Reduction Likely Appropriate" or higher. Reducing this level of risk addresses problems judged to have the highest likelihood of causing the canal embankment to fail, or which would present the greatest hazard to life and property should failure occur. Addressing problems at RR1 is a part of reducing risk at all risk levels.

- **Risk Rating 2 (RR2) –** "Long-Term Risk Reduction Action May Be Appropriate" and higher (includes RR1). Reducing this level of risk includes actions to reduce risk at RR1 and, additionally, addresses problems judged to have a slightly lower likelihood of causing the canal embankment to fail.

- **Risk Rating 3 (RR3) –** "Long-Term Action May Be Necessary to Maintain Agency Credibility" and higher (includes RR2). Reducing this level of risk includes actions to reduce risk at RR2 and, additionally, addresses problems that have a very high likelihood of causing the canal embankment to fail, but would result in the lower-hazard consequences.

To estimate costs, the study focused on implementing the structural alternatives proposed by the 2011 Report of Findings. Total estimated costs vary by the options selected, but range between $30 million and $50 million. Decommissioning the Truckee Canal was estimated to cost approximately $10 million. These cost estimates were developed for construction only; none include costs related to environmental permitting or mitigation.

USFWS

As the single largest user of Newlands Project water, USFWS functions as both a Project landowner and as a steward of the Lahontan Valley wetlands.

Stillwater NWR Complex Comprehensive Conservation Plan and Boundary Revision (2002) USFWS is implementing a comprehensive conservation plan (CCP) for the Stillwater NWR Complex, which includes the Stillwater NWR, Fallon NWR, and Anaho Island NWR (USFWS 2002). The plan provides a 15-year strategy for managing wildlife, habitat, and public uses at the Stillwater NWR under the direction established by Public Law101-618 and for managing the increased volume of water to be acquired from the Carson Division and delivered to the refuge under the Lahontan Valley Wetlands Water Rights Acquisition Program.

The CCP outlines habitat objectives that focus on providing a range of habitat conditions in the marshes, with an emphasis on breeding habitat, as well as restoring and protecting riparian, wet meadow, and sensitive upland areas such as the dunes. Water management goals are intended to mimic the natural seasonal pattern of inflow to minimize nest flooding to provide fall and winter habitat for waterfowl and waterfowl hunting.

In addition to maintaining hunting as an integral part of the visitor services program, the CCP provides for enhanced opportunities for a balance of wildlife-dependent public uses such as environmental education and interpretation, and wildlife observation and photography. The CCP also increased the cultural resources management program at the Stillwater NWR Complex.

Banking on Nature (2007) USFWS estimated the economic benefit provided by national wildlife refuges to local communities (USFWS 2007a). The analysis does not specifically address the economic benefits associated with the Stillwater NWR. However, the economic benefits generated by refuges lend support to public expenditures incurred to maintain refuges and enhance their functionality, such as the Water Rights Acquisition Program that purchases water rights from agricultural users in the Carson Division to improve wetland habitat at the Stillwater NWR.

The study's analysis focused on the benefits derived from visits to wildlife refuges and the increased expenditures within the local communities associated with the visits. The two primary data sources for the analysis included the *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (USFWS 2007b) and the *Refuge Annual Performance Plan* (USFWS 2006). These data sources provided information regarding the level and pattern of refuge-based visitation, typical expenditures by category (such as food, hotel, fuel), and type of visitor (such as wildlife viewer, hunter, fisher). The information was applied to a regional input-output model to estimate the positive economic effects associated with the recreational opportunities provided by NWRs throughout the United States. Results indicated the economic importance of wildlife refuges. In total, the report estimated that more than $1.7 billion is spent annually in support of wildlife-related activities at refuges, and the refuge system supports nearly 27,000 jobs nationally.

Court Decrees, Agreements, and Operational Rules

The Carson and Truckee basins have longstanding cultural, environmental, and other values, and since the mid-nineteenth century have also been used as a source of water for agricultural, industrial and municipal purposes. Plans and infrastructure built for managing the Carson and Truckee rivers basins were executed in a period where values were different than they are today. The arid climate of northern Nevada, combined with the sensitivity of the various desired uses for water, has resulted in fierce competition for both basins' limited resources.

Several frameworks have been put in place to help manage water use in the Truckee and Carson river basins. Listed chronologically, these are described below with their enactment dates noted in parentheses.

Truckee River Agreement (1935)   The Truckee River Agreement, signed in 1935 by Reclamation, TCID, Sierra Pacific Power Company (now TMWA), and other local Truckee River water users represented by WCWCD, established how the Truckee River would be managed to serve users downstream from Lake Tahoe Dam. In doing so, it also confirmed the agreed-upon rates of flow required in the river when it crosses the California/Nevada state line.

Rates of flow identified in the agreement are slightly modified versions of rates (called "Floriston rates") established in prior agreements regarding management of the Truckee River, such as the 1915 *Truckee River General Electric* Decree. Depending on the time of year and water elevation at Lake Tahoe, the average (mean) flow in the Truckee River at the U.S. Geological Survey (USGS) gaging station near Farad, California, must remain at a minimum rate that varies between 300 and 500 cfs. If these rates are not met by the Truckee River's natural flow, Reclamation must release additional water from reservoirs, such as Lake Tahoe Dam and Boca Dam, until the rates are achieved.

Orr Ditch Decree (1944)   The *Orr Ditch* Decree quantified individual Truckee River water rights in Nevada. It established amount, places, types of use, and priorities of the various rights, including those of the Pyramid Lake Paiute Tribe (Claims 1 and 2) and the Federal government on behalf of the Newlands Project (Claim 3). The U.S. District Court Federal Water Master in Reno, Nevada, enforces the terms of the decree.

Alpine Decree (1980) The *Alpine* Decree documented Carson River water rights in California and Nevada, and is the primary means by which the river and its reservoirs are operated, also overseen by the Federal Water Master.

The decree divided the Carson River into eight segments to be operated independently when water levels in the river were lower than usual and junior rights holders might not be served; as Section 8, the Newlands Project uses water that cannot be stored or used legally upstream.

For the Newlands Project, the *Alpine* Decree defined the annual net consumptive use of surface water for irrigation at 2.99 acre-feet, a water duty of 4.5 acre-feet per acre for bench lands, and a 3.5 acre-feet per acre duty for bottom lands. Although the decree established water duties for bench and bottom lands, it did not identify which lands received these classifications (DWP 1999). For lands above Lahontan Reservoir, the decree established water duties of 4.5 acre-feet per acre for bottom-lands, 6 acre-feet per acre diverted for alluvial fan lands, and 9 acre-feet per acre for bench lands; consumptive use for irrigation was set at 2.5 acre-feet.

OCAP (1997) In 1997, Reclamation issued the most recent version of the Newlands Project OCAP, which is intended to protect service of Project water rights; regulate diversions from the Truckee River to only the amount needed to serve Project water rights; and maximize the Project's use of Carson River supplies. OCAP sets diversions based on annual estimates of irrigated acreage and dictates other components of how TCID must operate and maintain the Project.

The 1997 OCAP incorporated numerous considerations and criteria that address conditions that have been developing throughout the study area since 1967. In February 1967, Pyramid Lake reached its lowest elevation in recent history (3,783.9 feet mean sea level). Shortly thereafter, the Pyramid Lake cui-ui fish species was identified as in danger of extinction under the Federal Endangered Species Act of 1966 (ESA). In response to these factors, Reclamation issued the first Newlands Project OCAP to limit and reduce the reliance of the Newlands Project on Truckee River diversions. In 1973, following the U.S. District Court finding of excessive Project diversions of Truckee River waters for the Newlands Project (*Pyramid Lake Paiute Tribe of Indians v. Rogers C.B. Morton, et al.*), OCAP was modified to reduce diversions from the Truckee River from 406,000 acre-feet (established in 1926 in agreements between TCID and Reclamation) to 350,000 acre-feet. The OCAP terms were subsequently updated at various times throughout the 1980s, and again in 1997 by Reclamation, resulting in further reductions to Project diversions of Truckee River water to its current amount in the range of 285,000 – 300,000 acre-feet.

TROA (2008) The Truckee River Operating Agreement (TROA) is a negotiated agreement for operation of federal reservoirs on the Truckee River upstream from Reno. Signatories to TROA include the U.S. Department of the

Interior, U.S. Department of Justice, Pyramid Lake Paiute Tribe, TMWA, and states of California and Nevada (Reclamation et al. 2008). The agreement is intended to assure coordination of the operation of those reservoirs for the purposes of storage, release, and exchange of water. TROA provides storage space which will increase municipal drought supplies, benefit instream flows for threatened and endangered fish species of Pyramid Lake and water quality purposes, and enhance reservoir levels for recreational use. In short, it provided flexibility to TROA parties and others for how reservoirs are operated to meet the needs of various – and sometimes competing – users of the Truckee River's water. Once TROA is implemented, it may result in Truckee River water users exercising their rights more efficiently throughout the basin. Section 205(a) of Public Law101-618 directed the Secretary for the Interior to negotiate the agreement, but also required that TROA ensure that water is stored in and released from Truckee River reservoirs to satisfy the exercise of Orr Ditch decree water rights.

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Chapter 2
Plan Formulation Process

This chapter describes the process for formulating and evaluating alternatives, consistent with the Study authorization, purpose, and objectives. The process relies upon characterizations of major water resources problems, needs, and opportunities in the primary study area and, if appropriate, extended study area, which provide the framework for plan formulation and help refine planning objectives for the Study. The process for developing alternatives for the Study parallels the general process for Federal water resources studies and projects, and involves iterative steps, consistent with the P&G (WRC 1983), as directed by the Study's authorization in Public Law 111-8 and pertinent Federal, State, and local laws and policies. The results of the plan formulation steps are documented in this Special Report, as follows:

- Defining water resources problems, needs, and opportunities to be addressed that are relevant to Federal, State, and local interests (Chapter 2).
- Developing planning objectives, constraints, considerations, and criteria (Chapter 2).
- Compiling, forecasting, and analyzing existing and likely future resources conditions in the study areas, and their relation to identified problems and opportunities (Chapter 3).
- Identifying potential management measures and combining them to form preliminary alternatives to meet the Study objectives given the planning constraints and other requirements (Chapter 4).
- Refining alternatives and evaluating their effects (Chapter 5).

Water Resources and Related Problems, Needs, and Opportunities

"Problems" and "needs" are conditions in which something needs to be repaired, changed, or addressed. "Opportunities" are prospects to create desirable future conditions – to make something better – through the planning process. This section describes water resources problems, needs, and opportunities identified in the primary study area. These were identified both in the Study's authorization and through stakeholder input regarding the existing and likely future water resources and other related issues in the primary and extended study areas.

Newlands Project Problems and Needs

The Truckee Canal breach in 2008, the canal's structural and safety issues, and the related water supply reliability concerns are the most discrete problems that led to development of this Study. However, the Project's broader cultural and institutional context is also shaped by a number of problems and issues that have persistently challenged operations.

Water Rights Problems and Needs

Reclamation and its local contractor, TCID, are obligated to serve Project water rights holders who intend to exercise their rights. However, the Project's changing makeup has complicated the delivery of water to its diverse blend of users. While these changing demands are not considered a problem, serving Project water rights holders is an important need that will be considered as the Study alternatives are formulated.

As originally envisioned, the Project would irrigate hundreds of thousands of acres dedicated to agricultural production. Soon after the Project began, the challenges of farming in an arid climate adjusted the perceived potential for irrigated land within the Project down from over 250,000 acres to fewer than 100,000 acres. Over the last century, several factors, including urban growth in Fallon and Fernley and the decline of ecosystems in the primary and extended study areas, have increased competition for water in the Truckee and Carson river basins and reduced the proportion of Project water delivered for agricultural uses relative to other uses. While Reclamation is committed to serving Project water rights holders, such trends present significant difficulties, as the examples below demonstrate.

- Federal, State, and locally funded programs have started acquiring and/or retiring Truckee River and Carson River water rights previously included in the Project. This has restricted the Project's operating flexibility and affected its ability to generate revenue.
- Many of the rights remaining in the Project are being transferred to nonagricultural users or are being retired. Truckee Division rights are increasingly dedicated to M&I uses or acquired for ecosystem restoration in the Truckee River; Carson Division rights are being acquired for wildlife refuge restoration; and rights throughout the Project are being retired to resolve administrative and judicial proceedings. These conversions have changed demand and delivery patterns, which increases operating complexity.
- As Project water rights are transferred within the basin to serve nonagricultural uses or outside of the basin to remain as in-stream flows, swaths of land previously under cultivation are laid fallow. As

once-continuous stretches of agricultural land are broken up, delivering water to Project farmers who wish to continue crop production can become extremely difficult, expensive, and inefficient.

Truckee Canal Risk-Related Problems and Needs

As evidenced by the 2008 breach, operating the Truckee Canal in its current condition to serve Project water rights holders presents large safety risks for residents and property, particularly in the Fernley area. The breach in 2008 was not the first structural failure of the Truckee Canal – eight other breaches occurred during the twentieth century. However, all of the previous breaches had occurred in rural areas (Reclamation 2008a) or at a time when the property adjacent to the canal was uninhabited. In 1996, the time of the second most recent breach, the population of Fernley was less than half of its current 12,000 residents. The rapid rate of urbanization along the Truckee Canal is highlighted by aerial photography in Figure 2-1, which shows the development of residential and commercial properties, in some cases, up to the toe of the Truckee Canal embankments.

Figure 2-1. Residential Growth in the Fernley Area: 1948, 2001, and 2008

In the months following the 2008 breach, Reclamation conducted examinations and forensic inspections to identify the factors leading to the embankment failure. These investigations identified a variety of factors that contributed to the failure, including rodent burrows and structural issues, and revealed that the same factors would continue to pose a safety risk unless actions were taken to improve the canal.

Since 2008, Reclamation has reviewed the risks of continuing to operate the Truckee Canal and has concluded that substantial improvements will be needed to allow the canal to safely convey as much water as it has historically. The facility's advanced age – around 110 years old – and structural issues make future breaches likely (Reclamation 2011d). Urbanization has increased the potential for a breach to cause damage, injuries, or deaths. Reclamation has weighed the high likelihood and increased consequences of a breach, and found the resulting risk to be unacceptable for a Federal facility (Reclamation 2008c, d). The combination of failures with high likelihoods and with high consequences has led Reclamation to require extensive rehabilitation actions, especially for the urbanized portions of the Truckee Canal (Reclamation 2011e). In the meantime, while options for reducing risk are being formulated and discussed, Reclamation has restricted the flow stages of the Truckee Canal.

Water Supply Reliability Problems and Needs

Restrictions on flow through the Truckee Canal, aimed at addressing Reclamation concerns for safety and risk, could reduce Project water supply to levels below the conditions experienced by users before the 2008 Truckee Canal breach.

Following the breach, Reclamation limited flows in the canal’s Fernley Reach, which includes the portion where the canal embankment failed. These limitations first restricted flow stages in the canal to 150 cfs, but were relaxed to 350 cfs by the end of 2008. In the ensuing years since the breach the Project has not experienced significant shortages due to a combination of hydrologic conditions that temporarily reduced the Carson Division’s reliance on diversions from the Truckee River. However, these recent hydrologic conditions have not diminished the Project’s long-term reliance on the Truckee River. Consequently, Truckee Canal capacity limitations that restrict flows to less than 350 cfs could increase the magnitude and/or frequency of Project water supply shortages in the future.

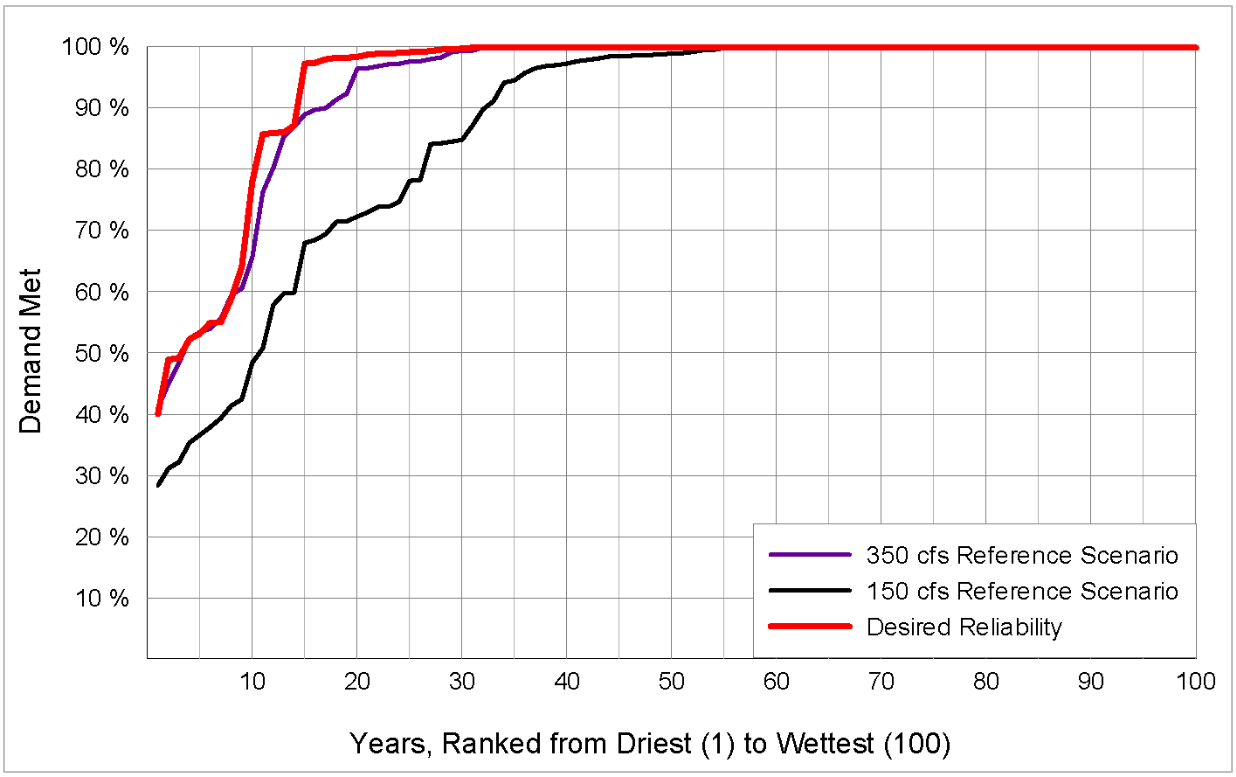
The potential for reduced Truckee Canal capacity to affect Project water supply is illustrated in Figure 2-2, which depicts 100 years of simulated water supply deliveries to Project water rights holders under different canal flow-stage scenarios, including:

- **Desired Reliability Scenario –** Represents the range of water supply conditions that Project water rights holders could have expected, had the 2008 canal breach not resulted in capacity restrictions. This scenario is based upon the current potential for water demand (225,461 acre-feet), existing regulatory conditions, including OCAP; and the Truckee Canal’s more recent maximum operating capacity of 900 cfs (from Derby Dam to Lahontan Reservoir).

  The Study’s estimate of the current potential for water demand is based upon an assessment of potentially active water rights, which include rights that have not been identified for retirement. This assessment is described in Appendix C (“Projected Future Water Rights and Demands for the Newlands Project”).

- **150 cfs and 350 cfs Scenarios** – Illustrates the anticipated water supply conditions that Project water rights holders might experience in the future, with flow-stage restrictions on the Truckee Canal of 150 and 350 cfs. These scenarios are based upon future conditions, as described in Chapter 3 ("Study Area Conditions"). The two selected flow stages (350 and 150 cfs) bracket the range of recent and likely future restrictions on the Truckee Canal, respectively.

  Both scenarios are based upon the ability of the Project to meet an anticipated future potential for water demand (216,332 acre-feet). The Study's estimate of the future potential for water demand is based upon an assessment of potentially active water rights that have not been retired, and includes anticipated completion of several water rights transfer and retirement programs. The assessment of future demand is described in greater detail in Appendix C ("Projected Future Water Rights and Demands for the Newlands Project").



Notes:
Simulations based on 100-year hydrology for the Truckee and Carson river basins, 1901–2000.
The Desired Reliability scenario considers the current Project demand; the other scenarios consider anticipated future demand, as discussed in Chapter 3 and Appendix C.
Key:
cfs = cubic feet per second

Figure 2-2. Potential for Restricted Truckee Canal Capacity to Affect Water Supply Reliability for the Newlands Project

Figure 2-2 illustrates the performance of the 350 and 150 scenarios, relative to the Desired Reliability. As mentioned earlier, both 350 and 150 cfs scenarios operate within the same 100-year period of hydrologic conditions, with the same future conditions, but with different canal capacities. Each line represents water supply conditions across the 100 years, ranked from driest to wettest; for any given year of the 100 evaluated, the figure shows the proportion of overall Project water rights that would have been satisfied.

Under the Desired Reliability, Project water rights holders receive at least 95 percent of their demand in 86 of the 100 years evaluated.[1] For driest year, Project water rights holders receive 40 percent of their water rights.

Under the 350 cfs scenario, Project water rights holders receive at least 95 percent of their demand in 80 of the 100 years evaluated; in the driest of year, Project water rights holders receive 40 percent of their demand. The largest difference in deliveries between the Desired Reliability and 350 cfs scenarios is approximately 10 percent of the annual demand.

Under the 150 cfs scenario, Project water rights holders receive at least 95 percent of their demand in 70 of the 100 years evaluated; in the driest of year, Project water rights holders receive 28 percent of their demand. The largest difference in deliveries between the Desired Reliability and 150 cfs scenarios is approximately 40 percent of the annual demand.

Appendix C to this report describes the current and future levels of demand formulated for use in these scenarios. Appendix D1 to this report describes the methodology used to develop an understanding of potential water supply across a range of potential future Truckee Canal capacity scenarios.

Opportunities

Whereas the problems and needs identified above must be addressed directly through development of the Study alternatives, the opportunities described below are other conditions that could also be improved through the planning process as a secondary outcome.

Project Efficiency

As Reclamation and others have long noted, many Project features and practices result in the inefficient use of Project water. For instance, the Project's aged conveyance structures, most of which are unlined, permit large amounts of water to seep into the ground before delivery. Among other consequences, this requires water to be diverted from the Truckee River not only to meet Project demands, but also to account for the water that is lost to seepage in the Truckee

[1] The frequency with which the Project experiences a shortage (less than 95 percent of demand met) under the Desired Reliability differs from the frequency reported in the TROA Environmental Impact Statement (EIS)/Environmental Impact Report (EIR). This is due primarily to the different approach this Study takes to calculate Project demand, which is not based solely on historical irrigated acreage within the Project. See Appendix C for an explanation of the Study's assumptions and analysis to estimate Project demand.

Canal. Similarly, seepage from the network of canals in the Carson Division means that more water must be released from Lahontan Reservoir than farmers and other users actually need; this water recharges groundwater basins, which does not directly benefit the Project. Conditions such as these present opportunities to improve the Project's efficiency by reducing delivery system losses, or otherwise improving the Project's ability to deliver more with its existing water supplies.

Water Quality and Quantity in the Lower Truckee River

Conflict and litigation over surface water in the Truckee River Basin have been ongoing for more than 100 years, and the Newlands Project has been a frequent party to these disputes. Chief among these disputes is litigation stemming from reductions to Pyramid Lake elevations and fish species. The Pyramid Lake Paiute Tribe considers the lake to be sacred, and the lake's indigenous fish species, cui-ui and Lahontan cutthroat trout, have a similar cultural importance. A number of factors have reduced the cumulative inflows from the Truckee River to Pyramid Lake, thereby challenging the viability of these fisheries. Over time, Project diversions from the river at Derby Dam have become the focus of efforts to reverse declines in water levels at Pyramid Lake and water quality in the Lower Truckee River. The result of these efforts has been a significant reduction in Project diversions from the Truckee River, in comparison to historical practices.

Additionally, the Truckee Canal's extremely high rate of seepage requires that the Project must divert more Truckee River water than Project users need to serve Project water rights. These losses have been exacerbated by the maintenance of high stages in the canal during periods of low use, such as during the winter when crops are idle and the only demands are for stock water.

Planning Objectives

This section discusses the objectives that will help direct the Study's planning process. Objectives help clarify the identified problems, needs, and opportunities; narrow the focus of Study efforts; and represent the basis for identifying and screening measures and formulating alternatives.

Study Objectives

Objectives for the Study were developed based on specific direction in the Study's authorizing legislation, identified water resources problems and opportunities in the study areas, and other guidance. Alternatives will be formulated to achieve the following Study objectives:

Address Truckee Canal Safety Concerns ("Safety Objective")

To meet the Study's safety objective, alternatives must include one or more elements to allow the Truckee Canal to be operated in a manner that is safe for the surrounding communities. Alternatives must do so in a manner that is consistent with Reclamation's preferred standards of safety for the canal, which address risks at the RR3 level (Reclamation 2011d, e). RR3 is described in greater detail in Chapters 1 and 3.

All Study alternatives will include corrective actions that Reclamation has already identified to meet the safety objective. Through a series of engineering studies noted in Chapters 1 and 3, Reclamation produced several design options and other actions to reduce risk from operating the Truckee Canal. The intent of this Study is not to improve upon or to replace these recommendations. Instead, this Study will incorporate them as part of comprehensive alternatives that also seek to resolve water supply problems.

Satisfy the Exercise of Newlands Project Water Rights ("Water Supply Objective")

Meeting the Study's water supply objective has two components: reliability and viability.

Reliability The Study's water supply objective requires providing water supply reliability to Project water rights holders, or mitigating water supply conditions that are less than reliable.

The Study interprets "reliability" to mean a condition that is approximately equivalent to the level of service Project users would have experienced from 1901 through 2000 if (1) the current OCAP regulations were in place, (2) the Project water rights in place today were held constant over the full period of study, (3) all holders of potentially active Project water rights fully exercised these rights, and (4) the Truckee Canal was operating without flow-stage capacity restrictions. These conditions are represented by the Desired Reliability scenario (Figure 2-2). Reliability under this scenario is summarized as follows and in Appendix D1:

- Over the full 100-year period of study, Project water rights holders would have received annually, on average, 95 percent of their water rights.

- In the driest 10 out of 100 years, Project rights holders would have received an average of about 50 percent of their water right, and as little as 40 percent in the driest year.

- In the second driest 10 out of 100 years, Project rights holders would have received an average of about 90 percent of their water rights.

- In the wettest 80 out of 100 years, Project rights holders would have received at least 98 percent of their water rights.

Viability The Study's water supply objective also requires that alternatives must maintain the viability of the Project. For the purposes of the Study, this means that alternatives should preserve the Project's current ability to generate revenue for ongoing O&M, in order to sustain itself.

National Planning Objectives

The P&G (WRC 1983) defines the Federal water resources planning objective as follows:

> *"The Federal objective of water and related resources Project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements…Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are direct net benefits that accrue in the planning area and the rest of the nation."*

As further refined in the Water Resources Development Act of 2007 (Public Law 110-114), the National Water Resources Planning Policy is for all Federal water resources investments to reflect national priorities, encourage economic development, and protect the environment by:

- Seeking to maximize sustainable economic development
- Seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used
- Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems

Although this Study has not been conducted solely with Federal interests in mind, the overarching Federal objective defined above provides useful guidance for developing alternatives that would address Federal priorities. Meeting this objective would be crucial for any alternative to garner Federal participation in cost-sharing.

Planning Constraints and Considerations

The following section describes the planning constraints, criteria, and other considerations for identifying planning measures and for formulating and evaluating alternatives.

Constraints

Constraints identify the basic concerns or issues specific to the Study that will shape the range of actions and measures the Study considers. Some planning constraints are rigid, such as congressional direction, current applicable laws and policies, and physical conditions. Other planning constraints, such as agency regulations and policies, are less stringent but are still influential in guiding the Study. Noted below are the preliminary constraints for the Study.

Study Authorization

In 2009, Congress authorized and appropriated funding for an investigation of opportunities to repair the Truckee Canal to the full extent needed to restore Newlands Project deliveries above 350 cfs (Public Law 111-8, 123 Statute 609). Thus, the alternatives must be developed to address the future use or nonuse of the Truckee Canal.

Laws, Regulations, and Policies

Numerous laws, regulations, executive orders, and policies may need to be considered, including: the P&G, National Environmental Policy Act (NEPA), Fish and Wildlife Coordination Act, Clean Air Act, Clean Water Act, National Historic Preservation Act, and ESA, among others.

Truckee River Agreement

The Truckee River Agreement signed in 1935 establishes how the Truckee River will be managed to serve its water users. It directs Reclamation to operate Lake Tahoe Dam so that as far as practicable the lake elevation will not exceed an elevation of 6,229.1 feet.

Limits on Truckee River Diversions

The 1997 OCAP and all previous versions since 1973 required that all Truckee River water in excess of valid Project water be delivered to Pyramid Lake. Additionally, it requires that Carson River water be the primary source for the Project and the Truckee River be a supplementary source to leave as much water as possible in the Truckee River for flows to Pyramid Lake.

Limits on Use of Upstream Truckee River Storage

Few opportunities exist currently for the Project to store water on the Truckee River. A 1982 court ruling limited the use of Washoe Project water in Stampede Reservoir on the Little Truckee River for flows to Pyramid Lake for endangered species. Although TROA will expand opportunities for many Truckee River water users to benefit from upstream storage, TCID and Project water rights holders are not signatories to the agreement. Additionally, based on recent court rulings, there may also be limitations on use of storage at Donner Lake – the rights to which are partially owned by TCID – to supplement Project water.

Other Considerations

The following considerations were identified to guide the formulation, evaluation, and comparison of alternatives.

- Alternatives should address the identified planning objectives.

- Alternatives should preserve the character of water rights as established under Federal court decrees.

- Alternatives should seek to avoid adverse impacts on environmental resources.

- Alternatives should seek to avoid adverse impacts to present or historical cultural resources.

- Alternatives will be based on a range of safe Truckee Canal flow stages.

- Initial reliability analysis, refinement of alternatives, and final alternatives are to be evaluated on a 100-year hydrologic period of record.

- Costs for alternatives are intended to be a basis for planning purposes only and are either preliminary- or appraisal-level, and represent field or total construction costs. Where available, existing estimates are used and reflect the most current pricing at the time of the estimate.

- Alternatives should have a high certainty of achieving the intended benefit and not significantly depend on speculative long-term actions for success.

- Alternatives should consider the purposes, operations, and limitations of existing projects and programs, and be formulated to not adversely impact those projects and programs.

- Alternatives should be formulated to neither preclude nor enhance development and implementation of TROA or other water resources programs and projects in the Truckee and Carson river basins.

Criteria for Formulating, Considering, and Evaluating Alternatives

The Federal planning process in the P&G includes four specific criteria for consideration in formulating and evaluating alternatives: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability (WRC 1983).

Completeness is a determination of whether an alternative includes all elements necessary to realize its effects, and accounts for the degree that the alternative's intended benefits depend on the actions of others. Effectiveness is the extent to which an alternative alleviates problems and achieves identified objectives. Efficiency is the measure of how efficiently an alternative alleviates identified problems while realizing the objectives. Acceptability is the workability and viability of an alternative with respect to its potential acceptance by the range of entities with vested interests in the Project's future, including other Federal agencies, State and local governments, public interest groups, and individuals.

These criteria and how they apply in helping to compare comprehensive alternatives are described in Chapter 5.

Chapter 3
Study Area Conditions

One of the most important elements of any water resources planning evaluation is defining existing resource conditions in the affected environment, and how these conditions may change in the future. The magnitude of change anticipated not only influences the scope of the problems, needs, and opportunities considered during the planning process, but also the extent of related resources that could be influenced by possible actions taken to address them. Accordingly, this chapter describes current conditions and likely future without-action conditions for resources within the study area. Defining these conditions is critical in establishing the basis for evaluating the effects of potential alternatives. This Study assumes that the future condition will occur by 2050 at the latest, although a firm date for the planning horizon is not necessary.

This chapter discusses existing and future infrastructure, resources, and other conditions in the primary study area that are of particular importance and relevance to the Study. This chapter focuses on the primary study area, but also provides information and context related to the extended study area, which includes the Truckee River Basin, Carson River Basin and Lahontan Valley, and Dixie Valley, where appropriate.

Infrastructure

This section describes the current conditions and likely future without-action conditions related to key infrastructure in the primary study area, as well as other relevant infrastructure, used to support water storage and distribution for the Newlands Project.

Current Conditions

Primary study area infrastructure includes Project water control and distribution facilities: major highways, rail lines and transportation corridors, as well as energy production and distribution facilities.

Newlands Project

With passage of the Reclamation Act of 1902, Reclamation began construction of Newlands Project facilities. Derby Dam was one of the first structures to be built under the Reclamation Act. Other Newlands Project facilities include Tahoe Dam, Lahontan Dam and Reservoir, Carson Diversion Dam, Old Lahontan Powerplant, the Truckee Canal, and the lateral and drainage canal system. Facilities of the Newlands Project are described below in the relative order in which Truckee River water flows through them, first in the Truckee Division and then in the Carson Division.

Lake Tahoe Dam Lake Tahoe Dam (Figure 3-1), located on the lake's northwest shore in Tahoe City, California, controls the top 6.1 feet of Lake Tahoe and regulates the flow into the Truckee River. With the large surface area of the lake, this relatively small change in lake elevation produces a reservoir capacity of 744,000-acre-feet. Completed in 1913, Lake Tahoe Dam is a concrete slab and buttress structure 18 feet high and 109 feet long. Seventeen vertical gates 5 feet tall by 4 feet wide control flow into the Truckee River.

Figure 3-1. Lake Tahoe Dam

Derby Dam Derby Dam, located on the Truckee River about 20 miles downstream from Reno, diverts water into the Truckee Canal for irrigation of Truckee Division lands and for conveyance 32 miles to Lahontan Reservoir (Figure 3-2). The dam is a concrete structure 31 feet high and was completed in 1905. This was the first structure to be completed by the U.S. Reclamation Service under the Reclamation Act of 1902 (NDWR 1997).

Truckee Canal The Truckee Canal extends 32 miles from Derby Dam to Lahontan Reservoir. It was completed in 1905 (Figure 3-2 and 3-3). The canal serves a dual purpose: delivering water to water rights holders near Fernley and in the Hazen and Swingle Bench areas, and transporting Truckee River supplies to Lahontan Reservoir when needed to meet Carson Division demands.

Figure 3-2. Derby Dam and Truckee Canal

For the purpose of identifying risks associated with the Truckee Canal, Reclamation divided the canal into three "reaches," shown on Figure 3-4: the Derby Reach extends approximately 10.3 miles from Derby Dam to the TC-1 lateral diversion turnout; the Fernley Reach encompasses 11.1 miles from the TC-1 lateral to the Tedford Road Bridge; and the Lahontan Reach runs approximately

9.7 miles from the Tedford Road Bridge to the canal’s outlet at Lahontan Reservoir. The January 2008 canal breach and flood occurred in the Fernley Reach.

The Truckee Canal’s conveyance features include three 15.3-foot-wide tunnels ranging from 309 feet to 1,521 feet long, and includes both concrete-lined and unlined earthen canal sections. There are two wasteway structures (Derby (Pyramid) and Gilpin wasteways), two flow measurement features (Wadsworth and Hazen, located approximately 7.6 miles and 27.9 miles, respectively, downstream from Derby Dam), five check structures, fourteen laterals, and an unspecified number of takeout structures (Reclamation 2008c).

Figure 3-3. Lined and Unlined Sections of the Truckee Canal

The canal has an initial bottom width of 20 feet and a maximum depth of 13 feet. As designed, the canal has an initial capacity that corresponds to an unchecked flow of 1,500 cfs and an ending capacity of 900 cfs. Canal operations are discussed in the “Water Resources” section of this chapter.

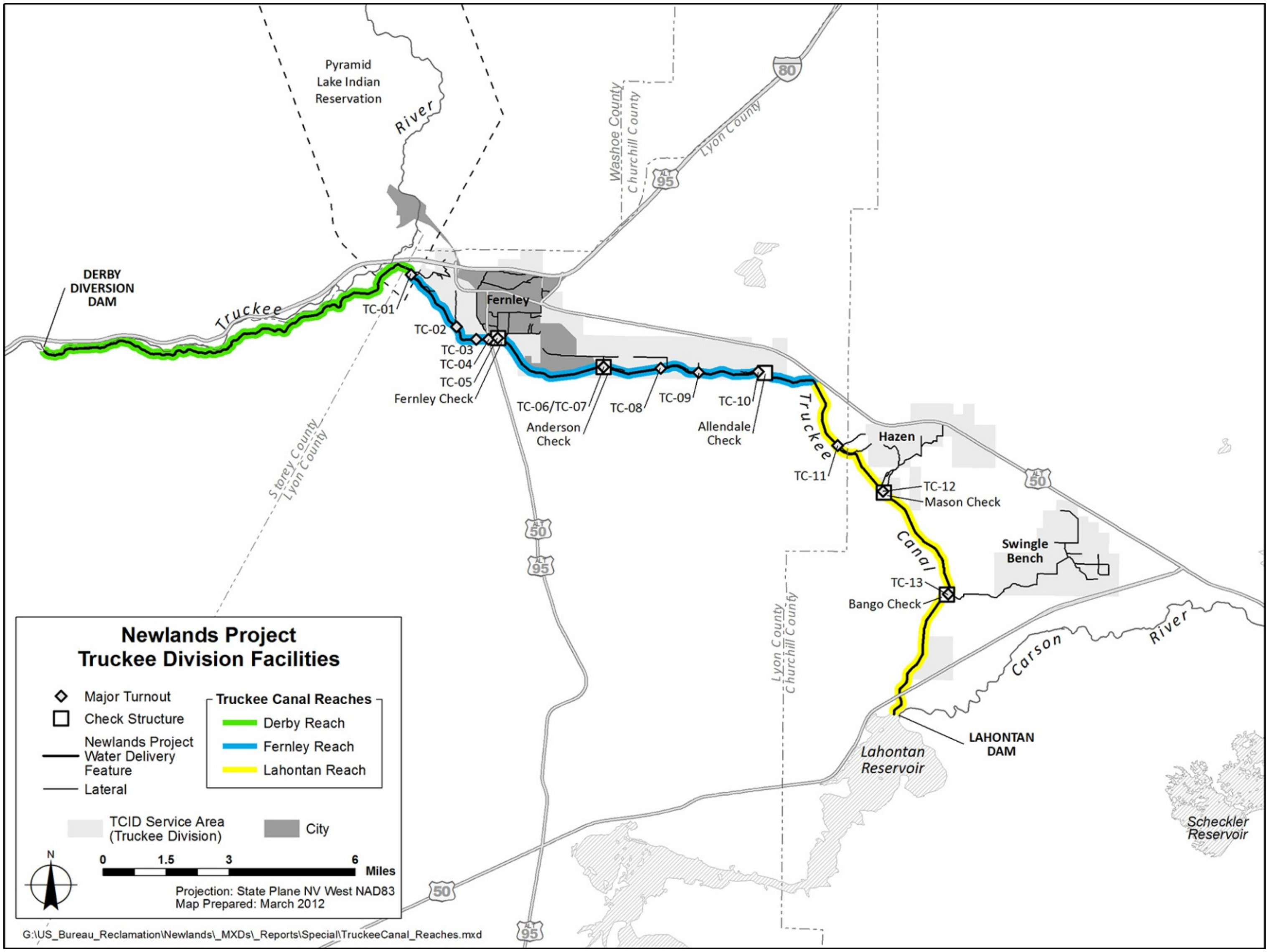


Figure 3-4. Truckee Canal Reaches and Control Structures

Following the January 2008 canal breach and subsequent flooding, Reclamation concerns about the safety of the Truckee Canal led to restrictions on the canal flow stages and congressional direction to investigate the risks and repairs necessary for resuming operations at capacities above 350 cfs. Risk assessments were conducted for each reach of the Truckee Canal, and for flow stages associated with 250, 350, and 600 cfs. These assessments considered the likelihood of 12 separate processes that would lead to a failure on the Truckee Canal, termed failure modes, and evaluated the potential consequences to public health and safety that would result from each. The identified general failure modes are summarized in Table 3-1, and represent a range of potential static, hydrologic, and seismic failures for the full canal structure and its individual reaches. Reclamation's standards for the safety of canals include meeting a preferred level of risk (RR3), which is discussed at length in the separate risk assessments (Reclamation 2011a, b, c, d) and also described in Chapter 1.

Table 3-1. Summary of Potential Failure Modes Identified for the Truckee Canal

Number	Failure Mode	Type of Failure Mode	Description of Failure
FM1	Canal failure due to internal erosion and piping of the embankment	Static	Tree roots, animal burrows, and other disturbances have created cavities in the canal embankment, producing pathways for seepage that extend almost or completely through the embankment. An increase in water in the canal causes water to enter the seepage points. Water flows out of the landside face of the canal embankment and begins erosion of embankment materials ("piping"). The type of soil or embankment condition contributes to erosion acceleration. The pipe widens rapidly, and the canal fails.
FM2	Canal failure due to internal erosion and piping of the foundation	Static	As with FM1, disturbances have created pathways almost or completely through the canal foundation. An increase in water in the canal causes water to rise above the entrance to the seepage points. Water flows out of the foundation downstream from embankment toe or the landside face of canal embankment and initiates piping. The poor foundation condition contributes to the progression of the erosion, and the canal fails.
FM3	Failure through the embankment caused by loss of slope stability	Static	A sudden drawdown of the canal water surface could result in excess pore-pressures within the embankment. This causes a slope failure into the canal that completely blocks the flow within the canal. Water backs up, causing overtopping upstream. If the slope failure deformations are large enough, water flows behind the slumped area, further eroding the embankment and resulting in a breach.
FM4	Failure due to tunnel collapse leading to overtopping of the canal	Static	During normal static conditions, a portion of the canal tunnel collapses due to loss of interlocking forces between rock blocks. The collapsed rock material blocks the flow within the canal. Water backs up, causing overtopping in the canal section upstream. Overtopping would occur at the emergency wasteways and possibly other locations. If overtopping occurs at an embankment section constructed of erodible soils, the embankment will likely wash away and cause a breach.
FM5	Failure due to blockages in the canal such as ice jams and debris blockage, which results in a sudden increase in the canal water surface and subsequent failure due to piping or overtopping	Static	An ice jam forms in the canal during winter diversions or debris is deposited in the canal any time during the year, blocking the flow of water. The water level within the canal rises suddenly, initiating internal erosion through existing flaws and causing the canal to fail. Or, the canal does not fail and rising water levels eventually overtop the canal bank. Overtopping erodes the embankment, causing a canal breach.
FM6	Failure due to overtopping caused by a large sudden increase in the canal water surface elevation during a hydrologic event	Hydrologic	A large hydrologic event occurs in the drainage basins adjacent to the canal, and precipitation causes runoff into the canal. The volume of the runoff is too great for the canal spillway and wasteways when combined with canal flows, and the canal overtops. Overtopping erodes the embankment, causing a canal breach.

Table 3-1. Summary of Potential Failure Modes Identified for the Truckee Canal (contd.)

Number	Failure Mode	Type of Failure Mode	Description of Failure
FM7	Failure due to sediment deposition into the canal from uphill drainage creating a blockage leading to overtopping	Hydrologic	A large hydrologic event occurs in the drainage basins adjacent to the canal. The precipitation causes runoff into the canal carrying large volumes of sediment that are deposited into the invert of the canal. The canal capacity is reduced or completely impeded, causing canal flows to back up and overtop. Overtopping erodes the embankment, causing a canal breach.
FM8	Failure due to internal erosion and piping caused by a large sudden increase in the canal water surface during a hydrologic event/sediment deposition	Hydrologic	A sudden increase in the canal water surface exposes a flaw, such as an animal burrow, in the embankment higher than the normal operating level of the canal, resulting in a concentrated leak. Water flows out of the landside face of the canal embankment and begins piping. The type of soil or embankment condition contributes to erosion acceleration. The pipe widens rapidly, and the canal fails.
FM9	Failure due to the Truckee River undercutting the canal foundation	Hydrologic	The Truckee River migrates into the foundation of the canal embankment by natural erosion processes in the Derby Reach, undercutting the canal. The river continues to erode the foundation soils, transporting the material downstream. Eventually, enough material is removed beneath the embankment that the crest collapses and the canal overtops. Overtopping erodes the embankment, causing a canal breach.
FM10	Liquefaction of the canal embankment and subsequent deformation of the canal results in failure due to overtopping or significant cracking	Seismic	An earthquake large enough to cause liquefaction of the canal embankment and/or foundation materials occurs, and liquefiable materials have enough continuity to cause instability. Once liquefaction occurs, the liquefied soils experience considerable strength loss which results in slope instability and deformation. Once the deformation occurs, canal failure occurs in one of two ways. The resulting slope failure leads to deformation and crest loss that is sufficient to intercept the canal water surface, which leads to overtopping. Overtopping erodes the embankment, causing a canal breach. Or, a severely deformed section with some amount of freeboard remains and prevents immediate overtopping and breaching of the canal remnant, but contains cracks that introduce seepage. Erosion through the embankment progresses rapidly as material escapes beyond the landside slope. Internal erosion continues, creating a channel through the canal, which ultimately collapses and leads to crest overtopping, or the developing pipe progresses to the canal water surface. Overtopping or erosion causes a canal breach.

Table 3-1. Summary of Potential Failure Modes Identified for the Truckee Canal (contd.)

Number	Failure Mode	Type of Failure Mode	Description of Failure
FM11	A seismic event causes damage to the canal, such as a slope failure or cracking of the canal embankment, which results in failure of the canal embankment	Seismic	An earthquake occurs that is large enough to cause a slope failure of the canal embankment and/or produce defects in the canal, such as cracking of the canal embankment due to settlement of the foundation materials or offsets produced by a fault within the immediate vicinity of the canal. Once these events occur, canal failure is likely to occur in one of three ways. Slope failure leads to deformation and crest loss that is sufficient to intercept the canal water surface. Overtopping begins and erodes the embankment, causing a canal breach. Or, slope failure leads to some deformation, but some amount of freeboard remains and prevents immediate overtopping and breaching of the canal remnant. The deformed section contains cracks through the canal. The canal water surface is high enough to intercept the cracks, which introduces seepage. Erosion through the embankment progresses rapidly as material escapes beyond the landside slope. Internal erosion continues, creating a channel through the canal, which ultimately collapses and leads to crest overtopping, or the developing pipe progresses to the canal water surface. Overtopping or erosion causes a canal breach. Or, very little deformation occurs, but cracks form within the canal embankment and introduce potential seepage paths. Seepage through these cracks has enough flow to cause erosion of the canal embankment.
FM12	Failure due to tunnel collapse caused by a seismic event leading to overtopping of the canal	Seismic	During a strong seismic event, a portion of the canal tunnel collapses due to loss of interlocking forces between rock blocks. The collapsed rock material blocks the flow within the canal. Water backs up, causing overtopping in the canal section upstream. Overtopping would occur at the emergency wasteways and possibly other locations where it erodes away the embankment, causing a canal breach.

Reclamation's risk assessments provided the basis for a Corrective Action Study (Reclamation 2011e) that identified methods for resolving safety risks on the Truckee Canal and included appraisal-level cost estimates. The Corrective Action Study includes a matrix of options (Table 3-2) that consider the existing risks for each Truckee Canal reach; at flow stages of 600, 350, and 250 cfs; and identifies related actions necessary for reducing risk at the RR3 level and at two higher-risk standards (RR2 and RR1). Corrective Action Study alternatives developed to address risk at the RR3 standard also include all other actions to reduce risk at the lower levels. Meeting the RR1 and RR2 standards would address risks with a high or moderate likelihood of occurring, and/or with highest possible consequences for life and property; to meet the RR3 standard, an alternative would also address risks that present a low-hazard but are extremely likely to occur.

Table 3-2. Levels of Risk and Risk-Reduction Required for the Truckee Canal

LIKELIHOOD OF FAILURE	CONSEQUENCES OF FAILURE			
	LEVEL 1 (Low Hazard)	LEVEL 2 (Significant Hazard)	LEVEL 3 (High Hazard)	LEVEL 4 (High Hazard)
VERY HIGH (1/100)	Long term action may be appropriate to maintain agency credibility **(RR3)**	Long term risk reduction action likely appropriate **(RR1)**	Immediate risk reduction action may be appropriate **(RR1)**	Immediate action likely required **(RR1)**
HIGH (1/1,000)	Monitoring likely appropriate to maintain agency credibility	Long term risk reduction action may be appropriate **(RR2)**	Long term risk reduction action likely appropriate **(RR1)**	Immediate risk reduction action may be appropriate **(RR1)**
MODERATE (1/10,000)	Monitoring may be appropriate risk management activity	Monitoring likely appropriate risk management activity	Long term risk reduction action may be appropriate **(RR2)**	Long term risk reduction action likely appropriate **(RR1)**
LOW (<1/100,000)	No further action likely needed	Monitoring may be appropriate risk management activity	Monitoring likely appropriate risk management activity	Long term risk reduction action may be appropriate **(RR2)**
REMOTE	No further action likely needed	No further action likely needed	No further action likely needed	No further action likely needed
Potential Life Loss	0	0 to 1	1 to 10	10 to 100

Key:
RR1
RR2
RR3

As previously noted, in 2008 flow stage of 150 cfs was originally recommended as the maximum flow stage that could be safely allowed in the canal; however, Reclamation ultimately determined that limiting the Truckee Canal to flow stages of 350 cfs for the next 1-to-5 years would provide appropriately safe operations for the canal, contingent upon TCID meeting a number of requirements: preparation and implementation of a Reclamation-approved emergency action plan and standard operating procedures, and continued progress toward addressing concerns outlined in the 2008 Report of Findings. TCID satisfied these requirements for the short-term flow stage increase, and has operated the canal at a maximum flow stage of 350 cfs since May 2008.

Figure 3-5. Lahontan Dam

Lahontan Dam Lahontan Dam (Figure 3-5) is located on the Carson River and stores the river's natural flow along with Truckee River water diverted via the Truckee Canal (Figure 3-5). The dam, completed in 1915, is a zoned earthfill structure 162 feet high. To prevent seepage, a cutoff-wall extends 30 to 60 feet below the original ground surface and 6 to 8 feet above the surface and into the embankment. The reservoir has a storage capacity of 289,700 acre-feet. The dam has twin spillways, one at each end of the main dam, that discharge into a common stilling pool. The combined design capacity of the spillway system is 30,000 cfs. When 20-inch flashboards are installed on the spillway crest, up to 23,300 acre-feet of additional storage capacity is available in some years.

Old Lahontan Powerplant Old Lahontan Powerplant, completed in 1911, is a 1.9-megawatt (MW) plant immediately below the dam. Hydropower generation remains incidental to the primary water supply purposes of the Newlands Project, but helps generate revenue to finance TCID's operations and maintenance of the Project. The powerplant and related generation infrastructure are further described in the "Utilities" section below, and the Project's hydropower production capability is further described in Appendix B3 ("Newlands Project Hydropower Generation").

Carson Diversion Dam Carson Diversion Dam is on the Carson River 5 miles below Lahontan Dam. The dam diverts water into two main canals to irrigate Carson Division lands. Carson Diversion Dam is 241 feet long with a 225-foot long, 31-foot high concrete control section, and has a diversion capacity of 1,950 cfs. It was completed in 1906.

"V" and "T" Canals Two canals carry water from Carson Diversion Dam to Project lands. The "T" Canal serves lands on the north side of the Carson River. It is 9 miles long with a bottom width of 10 feet, and has an original design capacity of 450 cfs. The "V" Canal serves lands on the south side of the river and is 27 miles long. It has a bottom width of 22 feet and an original design capacity of 1,500 cfs. The capacities of the T and V canals have been reduced by encroachment and the loss of Lewis Wasteway, respectively.

Canal, Distribution and Drainage System Overall, the Project has 68.5 miles of main canals with a combined original diversion capacity of 2,000 cubic feet per second. In addition to the primary canals, more than 300 miles of laterals and almost 350 miles of drains have been constructed since 1904.

Regulating Reservoirs Several small downstream regulatory reservoirs are designed to aid in distributing water throughout the project. These include Sheckler, Old River, S Line, and Harmon reservoirs, as shown in Table 3-3 and Figure 3-6.

Table 3-3. Newlands Project Regulating Reservoirs

Reservoir Name	Approximate Capacity (acre-feet)	Purpose
Sheckler	27,600	Used only during high-flow years to capture drawdown/spill water from Lahontan Reservoir.
Old River	Unknown	Used only during high-flow years to capture drawdown/spill water from Lahontan Reservoir.
S Line	450	Captures excess flows for later use in the S Line Canal and is also used for delivery to one irrigator with a direct turnout
Harmon	2,973	Captures return flows and excess flows for later use in the S Line Canal.

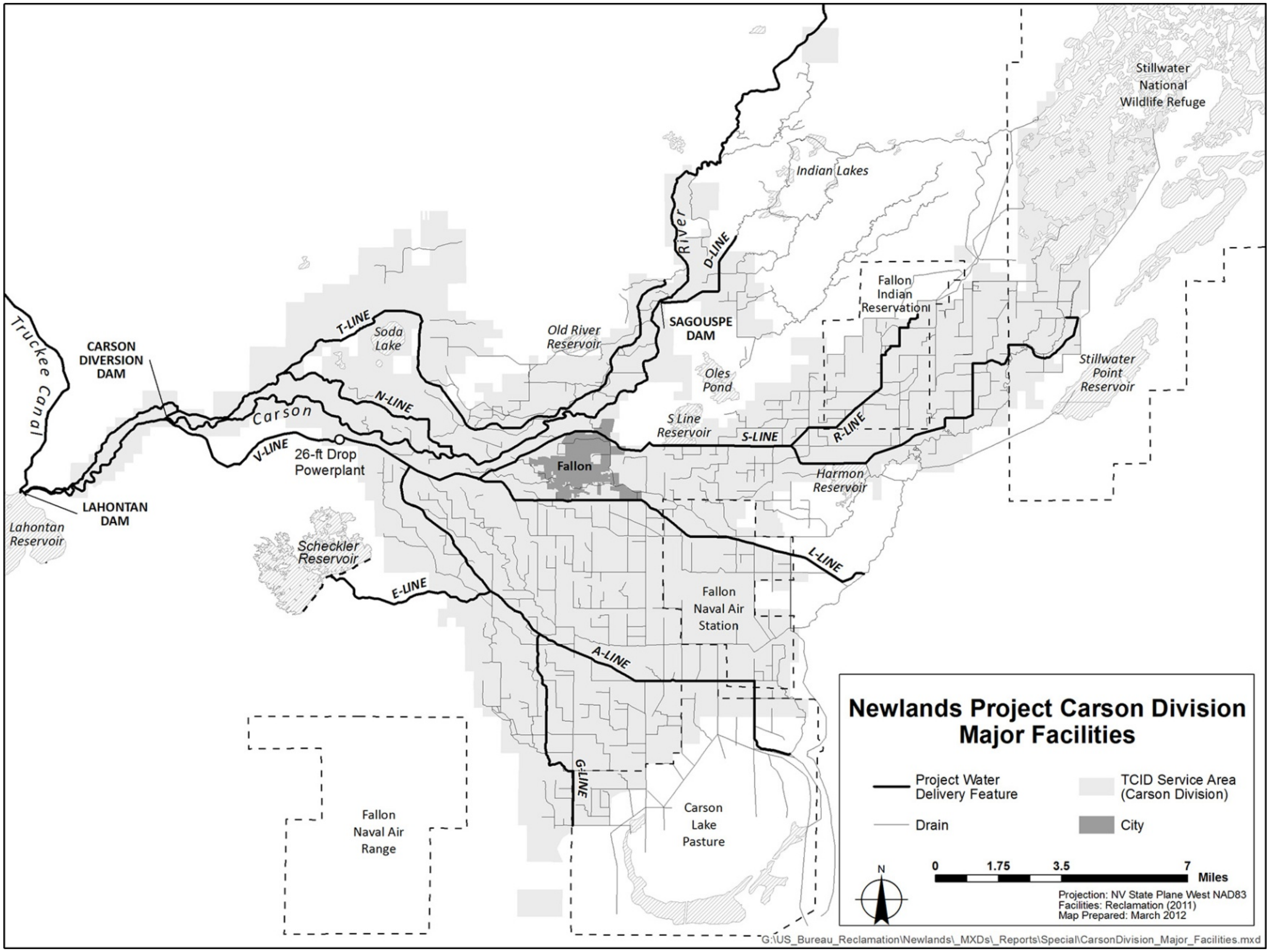


Figure 3-6. Major Facilities of the Carson Division

Transportation

The road system in the study area consists of a section of Interstate 80 (I-80), two U.S. highways, multiple rail lines, State highways, and State, county, local, and private roads.

I-80 passes through the northwest portion of the primary study area in Washoe, Storey, Lyon, and Churchill counties in an east-west direction. From Derby Dam to roughly Fernley, I-80 runs parallel to the Truckee Canal; for most of this stretch, the highway is less than a half-mile from the canal. Fernley is the largest urban community within the primary study area served by I-80, which subsequently takes a northeastern route into the extended study area (DeLorme 2010).

U.S. Highway 50 traverses the area in an east-west direction and U.S. Highway 95 runs north-south. Both highways also have alternate routes, which provide additional access within the study area. U.S. Highway 50 runs east-west through a portion of the study area, and is a major access route for the city of Fallon and NAS Fallon. Further west, Highway 50 runs along a portion of the northern edge of Lahontan Reservoir, and is also a primary access route for Lahontan State Recreation Area (Reclamation 1991). U.S. Highway 95 runs north-south through a portion of the primary study area in Churchill County, and is a major access route for the City of Fallon (DeLorme 2010).

The Lahontan State Recreation Area contains 40 miles of State roads, both paved and unpaved, which provide access to the recreation area’s entrance station, several beaches, and to campgrounds and other facilities (DeLorme 2010).

Rail lines for the Union Pacific Overland Route run alongside the Truckee River from Reno through the northern edge of Fernley, and take a northeastern turn out of the primary study area at Hazen (Union Pacific 2011, DeLorme 2010). From Hazen, Union Pacific rail lines also run southeast into Fallon, and south-southwest along the northern edges of Lahontan Reservoir through Silver Springs. Once the line reaches Wabuska, it is operated by the DOD as an access route to the Hawthorne Army Ammunition Depot.

Utilities

A variety of infrastructure to support the generation and transmission of power exists in the primary study area and extended study area.

Old Lahontan Powerplant has a capacity of 1,920 kilowatts (kW), and capabilities to use water from either Lahontan Reservoir or the Truckee Canal for electricity generation purposes. Its design takes advantage of the more than 100-foot fall of the Truckee Canal into the Carson River. In 1988, TCID constructed a second powerhouse (“New Lahontan”) at Lahontan Dam for a single 4,000-kW generator. TCID controls operation of both Lahontan plants, and in 1999 signed a 30-year lease agreement with the Sierra Pacific Power

Company for the sale and distribution of electricity generated at the dam (Reclamation 2011f, Nevada Energy 1999). There are 73 miles of 33-kilovolt (kV) transmission lines to convey power from this plant to Fallon, Fernley, Wadsworth, Hazen, Stillwater NWR, Indian reservations, and most of the rural areas within the primary study area. The V Canal powerplant (26-Foot Drop powerplant), also constructed and owned by TCID, is on a drop in the V Canal about 6 miles west of Fallon in the Carson Division. It has two 400-kWgenerators. In 2004, TCID signed a contract with Utah Associated Municipal Power Systems for sale of power generated at this facility. Over the past five years, the three plants have produced approximately 18 gigawatt hours of electricity per year, resulting in an average $1.2 million in annual electricity sales that is used by TCID to offset O&M costs for Project users.

Geothermal resources are used, or planned for use, in several locations within the primary study area and extended study area. The four geothermal power plants within or near the primary study area are Desert Peak, Soda Lake, Bradys, and Stillwater. Transmission lines greater than or equal to 55 kV crisscross the area, with some following major roadways and some of them passing through Fernley and Fallon (Reclamation 2011j). In the extended study area, the Dixie Valley Caithness plant is Nevada's largest single geothermal power generating facility, located about 100 kilometers northeast of Fallon.

Likely Future Without-Action Conditions

Two anticipated changes for infrastructure exist in the primary study area related to the Project: the condition and operating capacity of the Truckee Canal, and the mechanism used to deliver surface water for M&I use in the Truckee Division.

The risks identified for operating the Truckee Canal above a flow stage of 150 cfs, particularly in the urbanized sections of the canal near Fernley, require extensive correction to provide safe operation in the long term. Although in 2008, Reclamation issued TCID a short-term approval for operating at flow stages of 350 cfs, this approval is subject to reevaluation in the event that progress stalls in the development of a plan to repair the canal.

Presently, TCID has taken out a $5 million bond for rehabilitating the Truckee Canal. Specifically, $2.7 million of the bond funding is financing repairs to 33 Truckee Canal conduits, or takeouts used to make deliveries to water rights holders along the canal. The repair of these conduits represents a portion of the corrective actions recommended by Reclamation, but substantial risks remain within the canal even with the completion of the conduit repair.

Without detailed plans to complete Reclamation-required safety repairs to the Truckee Canal, Reclamation's approval for flow stages of 350 cfs will expire in 2013. A reevaluation of the canal would then be required to determine the level of flow that can be accommodated. Without capital improvements to the canal, this reevaluation is likely to result in further reductions to the allowable Truckee Canal flow stage to as low as 150 cfs, consistent with assessments of acceptable operating thresholds found in Reclamation's risk assessments (Reclamation 2011a, b, c, d).

Likely Future Without-Action Conditions: The "Likely Future Without-Action Conditions" describe the conditions anticipated in the primary study area in the absence of any Federal, state, or local actions or investments to address the identified problems and risks from the Truckee Canal. It is the same as the "no-action" alternative described NEPA regulations and includes reasonably foreseeable actions expected to occur in the future, especially those which are already authorized, funded, or permitted. For the purposes of this Study, the likely future without-action conditions provide a "baseline" against which to compare the range of future with-project conditions (what is expected to happen with implementation of the alternatives) in measuring the accomplishments of the alternatives toward addressing the identified problems. The likely future without-action conditions are not a prediction of what Reclamation or other agencies intend to do in the future, but an important forecast of potential future conditions that could result without implementing any of the alternatives.

The consequences of restricting the Truckee Canal to a maximum flow stage of 150 cfs have not been fully assessed; however, the Newlands Project would experience reduced water supply reliability as a result. Implications of the expected future flow-stage restrictions are described in the "Water Resources" section of this chapter and in Appendix D1 ("Effects of Truckee Canal Capacity on Newlands Project Water Supply").

The future condition also includes construction of a new surface water diversion and/or delivery system by the City of Fernley to exercise its Project rights to meet its anticipated municipal demand. The city has developed a plan outlining several options for such a facility, which could include a direct intake and pipeline from the Truckee River or a diversion from the Truckee Canal, potentially at the TC-1 lateral (City of Fernley 2011a; City of Fernley 2012). While the exact mechanism for receiving deliveries of Project water rights has not yet been selected, the City of Fernley has indicated a strong commitment to aggressively pursue this action (City of Fernley 2012).

Key Study Assumptions

Reclamation-required corrective actions to reduce the public safety risk of operating the Truckee Canal will not be implemented before the temporary 350 cfs flow-stage capacity restriction expires in 2013; for the purposes of this Study, the long-term Truckee Canal capacity restriction will be a flow stage of

150 cfs absent significant modification or rehabilitation. An explanation of flow stages and canal capacity restrictions appears in Appendix A (“Flow-Stage Relationships for the Truckee Canal”). Additionally, Fernley’s surface water rights will be served via a separate facility for diverting water directly from the Truckee River or from the Truckee Canal.

Physical Environment

This section describes the current conditions and likely future without-action conditions related to the physical environment, topography, geology and soils, climate, air quality, and noise in the primary study area. Where pertinent to the Study, descriptions also include the resources and conditions of the extended study area.

Current Conditions

Components of the primary study area physical environment described in this section include topography, geology and soils, climate, air quality, and noise. Water resources in the primary study area are discussed in the “Water Resources” section of this chapter.

Topography

The extended study area is located in the Great Basin, a hydrographic region that includes most of Nevada, half of Utah, and portions of California, Idaho, Oregon, and Wyoming (Figure 3-7). The Great Basin includes more than 180,000 square miles of contiguous, terminal basins, having no river or ocean outlet. Rain and snowmelt dominate the hydrologic processes for streams and rivers in the Great Basin.

The crest of the Sierra Nevada mountain range forms the southwestern boundaries of the Truckee and Carson river basins in the extended study area, with elevations ranging between 5,000 and 10,000+ feet mean sea level (msl) (Reclamation 2011j).

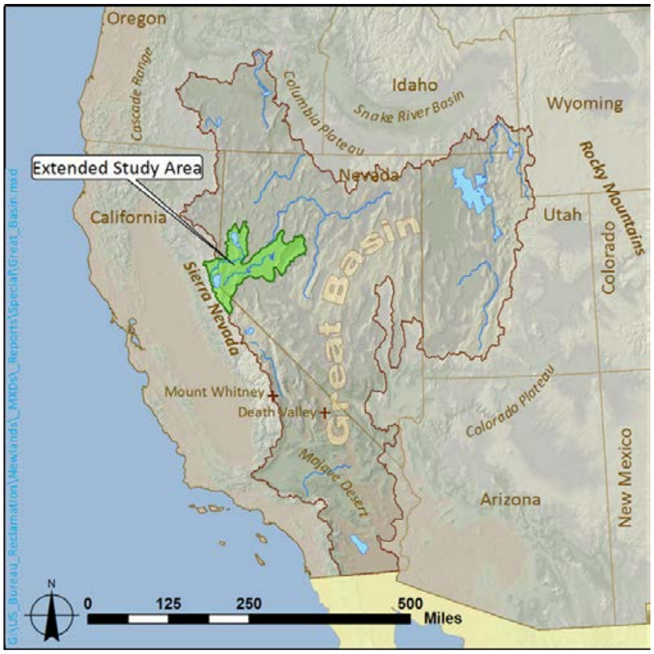


Figure 3-7. Boundaries of the Great Basin and the Extended Study Area

The primary study area focuses on the Newlands Project, most of which is part of the flat, northeastern end of the Carson River Basin, also called the Lahontan Valley. The Project has a less than 10 percent slope; many soils are reported with slopes of 1 percent (NRCS 2007). Elevations in the Project range from 4,213 feet at the crest of Derby Dam and 4,162 feet at the crest of Lahontan Dam to 4,150 feet in Fernley, 3,960 feet in Fallon (except for Rattlesnake Hill at 4,200 feet), and 3,870 feet where the northern end of the Stillwater NWR transitions into the Carson Sink.

The nearly level conditions within the Project influence water management practices (TCID 2010a). Wide, shallow, and slow-flowing canals and laterals deliver water within the Project. These nearly level conditions make it difficult to accurately measure water using traditional water-measuring devices that rely on a differential head to perform the measurement. The level conditions within the Project also make it harder to manage the water because of the longer time lag for water moving from one point to another. Water needs on the downstream end of the Project must be anticipated well in advance of actual needs.

Geology and Soils

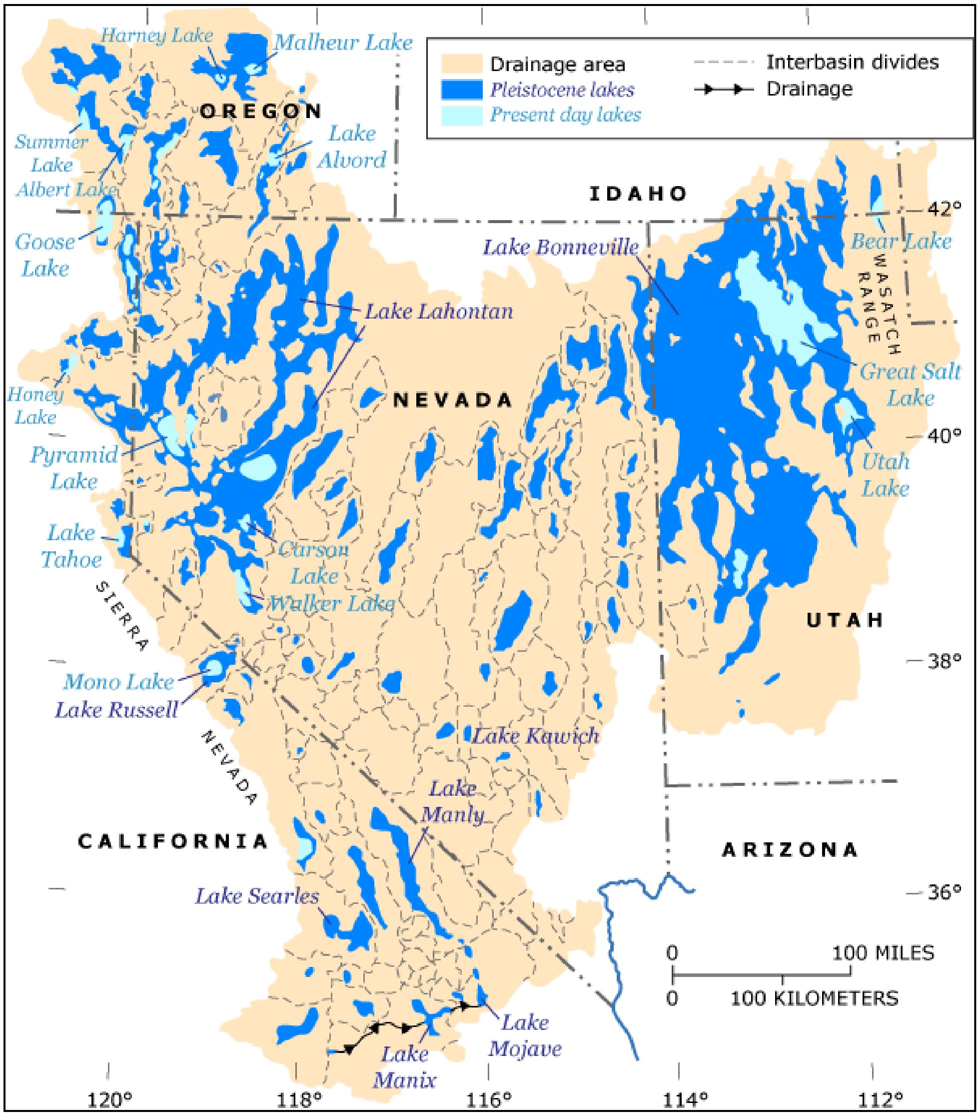
The current topography of the extended study area began to take shape about 25 million to 40 million years ago, when a block of granitic rock was tilted up on its east side to form the present-day Sierra Nevada (Reclamation et al. 2008). To the east, great faults broke the earth’s surface, and volcanoes discharged lava and ash over much of the landscape. Uplifted, north-trending blocks formed mountain ranges, and down-dropped blocks formed valleys, creating the Basin and Range topography.

By about 2 million to 3 million years ago, water filled many of the valleys of the Great Basin, at times coalescing to form huge lakes. One of these lakes was Lake Lahontan, which covered much of northwestern Nevada and a portion of northeastern California (Figure 3-8). At its maximum stage, about 50,000 years ago, Lake Lahontan occupied about 8,500 square miles. About 10,000 years ago, the climate began to warm, precipitation decreased, and Lake Lahontan receded until only a few remnants of the lake – Walker Lake, Honey Lake, and Pyramid Lake – remain today (Reclamation et al. 2008). Over thousands of years of activity and sedimentation, Lake Lahontan resulted in an estimated average sediment thickness of 3,000 feet underlying the basin (Reclamation 1990).

A historical geology continues to have localized influence in the extended study area. Throughout the Truckee River corridor, the bedrock is variably volcanic, metamorphic, and, in the lower reaches, sedimentary (Reclamation et al. 2008). In the lower Truckee River Basin, thick unconsolidated sedimentary deposits exist that have become deeply excised as the elevation of Pyramid Lake declined. Exposed tufa (calcium carbonate deposits that form below lake surfaces) provide evidence of a historically higher elevation.

The granite Sierra Nevada to the west and southwest and the volcanic Pine Nut, Desert, and Dead Camel mountain ranges to the east form the boundaries of the Carson River Basin (Tracy and Unger 2008, USGS 2011). Along the Middle Carson River, basin-fill and sand deposits line the river basin east to Lahontan Valley (USGS 2011). Downstream from Lahontan Reservoir, the geology becomes a complex combination of deposits consisting of organic-rich clays, sands, and gravels (Reclamation et al. 2008). Varying amounts of mineral salts remain in the sediments from evaporation in the internally drained basin.

The sedimentary soils in the primary study area are able to absorb large quantities of groundwater from flood irrigation and percolation from mountain streams. Further, they release large quantities of groundwater to ditches that partially or entirely rely on return flows from flood irrigation (Tracy and Unger 2008). The relatively flat soils underlying most of the primary study area are not highly susceptible to water erosion (Reclamation 2011j). Potential wind erosion ratings vary.



Source: USGS 2012a

Figure 3-8. Maximum Late Pleistocene Extent of Pluvial Lakes in the Great Basin

Periods of saturation, flooding, or ponding during the growing season develops anaerobic conditions in the upper layer of soils, creating hydric soils in the eastern portion of the primary study area (NRCS 2008). The Natural Resource Conservation Service (NRCS) classifies most of the soils in the primary study area as aridic, with sizeable areas receiving less than 8 inches of precipitation per year (Figure 3-9). Many soils in the primary study area have relatively high percentages of excess salts, including sodium, which affects soil structure and permeability, and limits vegetative species composition.

Because rainfall is low and evaporation is high, percolating rainfall is insufficient to leach salts out of the root zone. Soil salinity in the primary study area has responded well to farming practices. Some of these soils also have aquic moisture regimes due to a spatially diverse combination of steady and seasonally high water tables. The valley floor has deep, well-drained alluvium soils with varying amounts of coarse fragments in the soil profile. Some of the alluvial fan piedmont soils at the edge of the primary study area are shallow, with a silica cemented hardpan, and may contain a clayey or fine loamy textured horizon that contains excess sodium.

According to an analysis of NRCS soil survey data, the land between Carson Sink and Carson Lake contains flat, fine-textured, and moderately fine-textured soils on floodplains (TCID 2010b). These soils formed in alluvium of mixed origins and are used for crops and pasture, where irrigated, and for range and wildlife habitat, where not irrigated. The central farming area surrounding the City of Fallon and smaller areas near Fernley and along the Carson and Truckee rivers are generally flat, coarse-textured to moderately fine-textured soils on floodplains and low stream terraces (TCID 2010b).

Farming on cropland directly affects the soils. With the high excess salts in the soils, irrigation of the cropland includes drainage canals to allow the dissolved salts to be carried away from the productive soils. The irrigated land in the primary study area is grouped broadly as nearly level soils on floodplains and low lake terraces (NRCS 2007, TCID 2010a). Most of the irrigated area is between elevations of 3,850 and 4,050 feet, with the exception of the slightly higher Truckee Division (TCID 2010a). Farmed soils within the primary study area include soils with the potential to support prime farmland, as designated by the NRCS. Prime farmland has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Many areas not designated as prime farmland within the primary study area have been designated as farmland of statewide importance. This designation does not include prime farmland but does include soils with a good combination of physical and chemical characteristics for the production of crops. Unlike prime farmland, farmland of statewide importance does not have any restrictions regarding soil permeability or rooting depth (Reclamation 2011j).

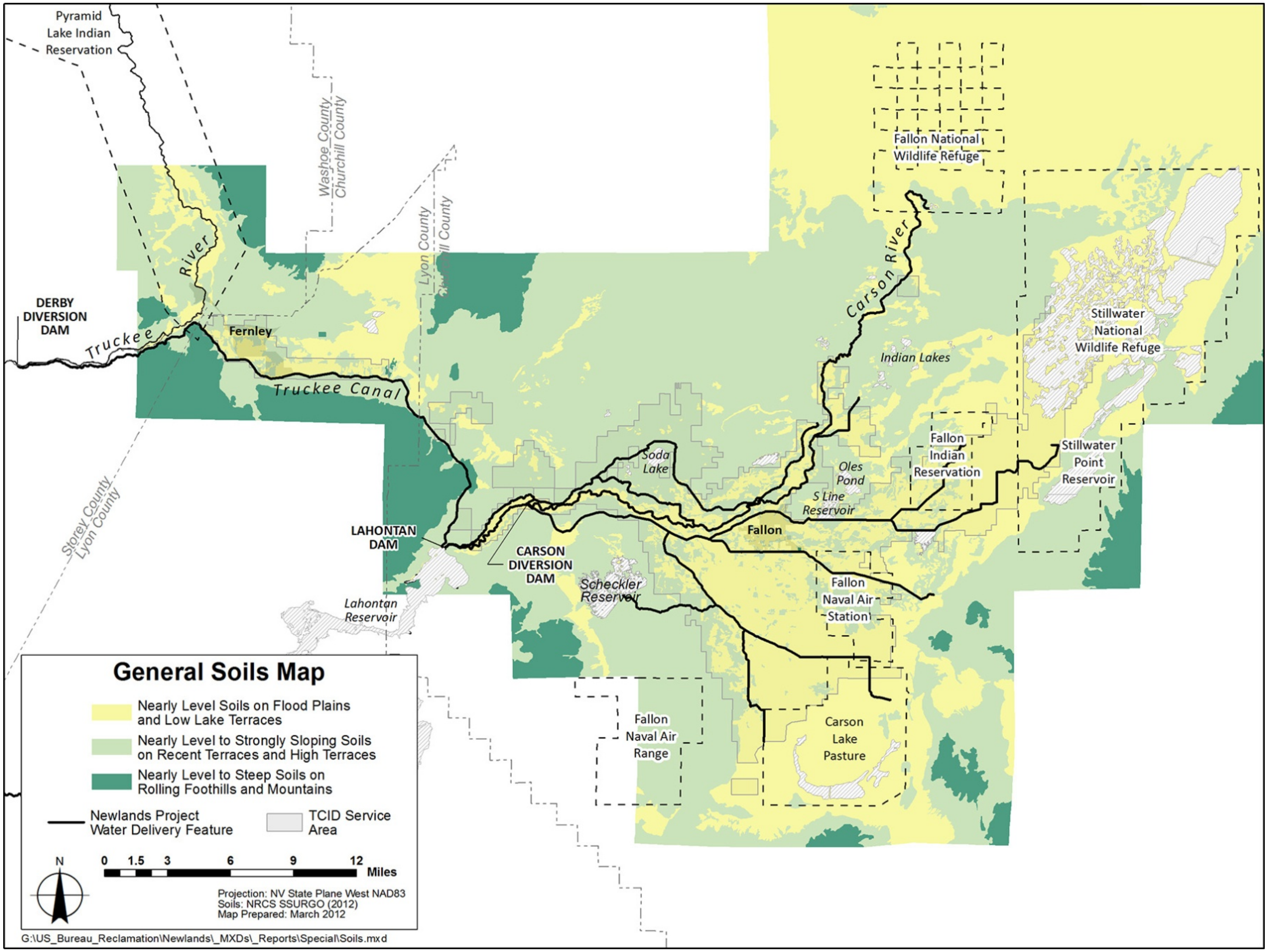


Figure 3-9. General Soil Map of the Study Area

Climate and Air Quality

The primary study area climate is typical of the Great Basin, with long, dry winters and short, dry summers (Reclamation 2011j). Annual precipitation in the Truckee River watershed below Farad is less than 10 inches. Ten miles upstream from Lahontan Reservoir, the Carson River watershed receives less than 8 inches annually (Reclamation 2011j). Precipitation declines toward the east; annual precipitation at Fallon is less than 5 inches (WRCC 2007). Approximately 92 percent of annual precipitation falls between October and May (Kennedy/Jenks/Chilton 1988). Winter precipitation in the primary study area typically falls as rain from large-scale weather systems. Summer precipitation occurs as rain from localized activity caused by solar heating, rising air, and associated thunderstorms. Further climate statistics are shown in Table 3-4 (adapted from Reclamation 2011j).

The western ranges of the extended study area have a climate influenced by weather from the Pacific Ocean. Warm, moist air traveling east from the Pacific ascends the western slopes of the Sierra Nevada and cools, condensing the moisture, which falls almost exclusively as snow in the mountains from November to April. Moving down the eastern slope of the Sierra, the air warms and results in minimal precipitation, creating a semiarid to arid climate in the lower regions of the extended study area (Reclamation et al. 2008).

Table 3-4. Climate Statistics for Fallon Experiment Station, 1903 – 2005

	October	November	December	January	February	March	April	May	June	July	August	September	Annual
Average Precipitation (inches)	0.39	0.38	0.47	0.53	0.54	0.45	0.49	0.61	0.44	0.16	0.22	0.29	4.98
Evapotranspiration (inches)	3.19	2.38	1.45	0.81	1.57	4.23	5.64	7.04	7.82	7.47	8.59	4.81	55.0
Average Temperature (degrees Fahrenheit)	51.5	40.1	32.3	31.2	37.2	43.4	49.9	57.7	65.5	73.0	70.7	62.1	51.2
Maximum Temperature (degrees Fahrenheit)	69.3	55.4	45.7	44.3	51.2	58.9	65.9	74.0	83.1	92.1	90.0	81.0	92.1
Minimum Temperature (degrees Fahrenheit)	33.7	24.8	19.0	18.0	23.1	27.8	33.9	41.4	47.9	53.9	51.3	43.1	18.0

Note:
Data collected at NOAA-Climatic Data Center Station 262780

Potential air quality concerns in the primary study area focus on particulate matter of 10 microns in aerometric diameter or less (PM_{10}) (Reclamation 2000). PM_{10} sources include dust from construction and farming activities and emissions from automobiles and aircraft. Particulate emissions in the Lahontan Valley are primarily due to the large percentage of lands that are desert with little vegetative cover. Wind blowing through the valley picks up dust from the desert floor and other exposed soils surfaces. PM_{10} monitoring sites have been operational in Fallon since 1993 and in Fernley since 1995, with no exceedances of the 24-hour standard.

Likely Future Without-Action Conditions

Physical conditions in the primary study area are expected to remain relatively unchanged in the future. No changes to primary study area topography, geology, or soils are foreseen.

However, numerous studies have projected that global and regional climates will change substantially in the future. Although this Study does not include assumptions of future climate change in its analyses, Reclamation is conducting separate investigations through the Westwide Climate Risk Assessments authorized under the SECURE Water Act of 2009 (Public Law 111-11) into how projections for future climate change may affect the study area. Initial results from these studies suggest that in the lower Truckee and Carson river basins, the overall temperature may increase 5 to 6 degrees Fahrenheit by the end of this century (Reclamation 2011l, m). The mean-annual precipitation for these basins is projected to remain relatively unchanged through 2050, and to decrease slightly during the latter half of this century. Additionally, the broader southwestern and south-central areas of the U.S. are projected to become more arid as precipitation decreases, and snowpack and runoff likewise decrease as a result, particularly during summer months.

Additionally, Reclamation has initiated several Basin Studies to investigate how potential climate changes could affect current water use (including water supply, flood control, and ecosystem needs) and to explore options for mitigating any negative consequences of climate change. Reclamation anticipates the completion of the Truckee Basin Study in 2014.

Most of the air pollutants in the study areas would continue to be influenced by both urban and agricultural land uses. If these populations grow, and more agricultural lands are converted to urban centers, a general degradation of air quality conditions could occur.

Biological Environment

This section describes the general habitat, fishery, and wildlife resources in the study area.

Current Conditions

The diversity of available habitats in the study areas, ranging from wetlands and riparian corridors to agricultural lands and desert shrub communities, supports numerous terrestrial species and aquatic species which are described below.

Vegetation and Habitat

In general, vegetation found in the primary study area is typical of the Great Basin. Salt-tolerant shrubs and playas prevail in the lower valleys. Expanses of sagebrush and other shrub communities cover most of the higher valleys and slopes, occasionally mixed with grasses, especially at higher elevations (NDCNR 2002). There is no federally proposed or designated Critical Habitat within the study area, and no federally listed plant species are known to occur (Reclamation 2011j).

Desert plant communities in the primary study area are composed of species that can tolerate moderate to highly alkaline soils and minimal precipitation. These communities can be described as greasewood, greasewood-shadscale, saltgrass, rabbitbrush, and sagebrush communities. Greasewood-shadscale is the most prevalent community type. There are no native trees associated with these desert shrub communities.

The Carson River corridor downstream from Lahontan Reservoir supports approximately 30 miles of riparian habitat. Cottonwoods (*Populus* sect.), common in Great Basin riparian woodlands, are widespread in Lahontan Valley due to the high water table associated with irrigation activities and use of the trees for landscaping and windbreaks (Figure 3-10). In addition, Newlands Project drains and canals have created conditions that resulted in development of strips of riparian habitat. Additionally, a number of

Figure 3-10. Cottonwood Trees Adjacent to Irrigation Ditches

drains and canals in the primary study area contain extensive populations of willows, cottonwoods, sedges, rushes, and cattails (Reclamation 2000).

Cottonwood trees surround Lahontan Reservoir, but lower reservoir operating levels and drought periods have combined to greatly reduce the number of live trees. However, the gallery cottonwood stands and willow understory in the area west of the Lahontan Reservoir delta are some of the most complete of such habitats in Nevada.

During much of the twentieth century, wetland habitat acreage in the Lahontan Valley was reduced from historical levels as a result of upstream water diversions. The timing of delivery of water into the marsh systems and playa no longer mimics natural conditions. Inflow to current wetlands is dictated by agricultural practice and comes in a reduced, protracted flow from March through November, usually without a substantial flushing flow in the spring. Episodic flooding, usually resulting from springtime snowmelt and runoff is usually intercepted by Lahontan Reservoir and stored for downstream irrigation purposes (Reclamation 2000). At present, emergent marsh is the most dominant wetland type in the primary study area. Other wetland communities in the Lahontan Valley included open water, wet meadow, alkali mud flats/playas, and shrub. The USFWS has estimated that under typical conditions, there are approximately 16,000 acres of wetland in the Lahontan Valley (Reclamation 2000).

Fisheries and Aquatic Resources

The primary study area includes marshes at Stillwater NWR, Carson Lake and Pasture, canals and historic river channels below Lahontan Dam, Lahontan Reservoir, Truckee Canal and Derby Dam. Native fish species that occur in the primary study area include tui chub (*Gila bicolor*), Lahontan redside shiners (*Richardsonius egregius*), speckled dace (*Rhinichtthus osculus*), Lahontan mountain suckers (*Catostomus platyrhynchus lahontan*), and Tahoe suckers (*Catostomus tahoensis*) (USFWS 1996a, Reclamation 2000).

Some water bodies in the primary study area have been extensively stocked in the past as part of game programs with numerous nonnative species. Nongame species generally have greater tolerance to the poor water quality found in the area (USFWS 1996a). In the past, Newlands Project regulating reservoirs and deeper wetlands in the primary study area supported a warm-water sport-fishery. Fifteen warm-water fish species have been reported to occur in Lahontan Valley. Lahontan Reservoir has historically supported one of the largest game fisheries in the State. The reservoir is eutrophic and moderately turbid, and contains numerous cool and warm-water species. Game fishing opportunities at other water bodies in the primary study area were less extensive. Wetlands at Stillwater NWR supported a number of warm-water game fish species (USFWS 1996a). The lower Carson River supported a small, seasonal cold-water fishery limited by poor habitat quality. Mercury contamination from historic mining activities in lake sediments of Lahontan

Reservoir, Carson Lake, Stillwater NWR and in the floodplain of Carson River have resulted in public health advisories recommending limiting consumption of fish from these areas (EPA 2012).

Figure 3-11. Cui-ui at Marble Bluff Dam

Project regulating reservoirs and wetlands continued to support good fishing opportunities until drought conditions in the early 1990s significantly reduced or eliminated available water resources. Drought and requirements for greater Newlands Project water distribution efficiency have diminished the Lahontan Valley sport-fishery to the point that, except for at Lahontan Reservoir, it is nearly nonexistent (USFWS 1996a, Reclamation 2000). As in the case with Lahontan Valley wetlands, fish habitat in Lahontan Reservoir is dependent on the volume of inflow to the reservoir. During the early 1990s when drought conditions prevailed, a combination of low water levels, high water temperatures, and extensive algae growth resulted in low oxygen concentrations in the reservoir, which negatively affect the fish populations. Conditions in the reservoir improve as the volume of Carson River inflow increases due to above-average precipitation and runoff.

In the extended study area, species of particular importance include cui-ui (*Chasmistes cujus*) and Lahontan cutthroat trout (LCT) (*Oncorhynchus clarki henshawi*). Cui-ui occurs only in Pyramid Lake, with spawning runs in the Truckee River (Figure 3-11). Historically, the species spawned in the lower 43 miles of the Truckee River, but recent data indicate that spawners use less than 6 miles of the 12 miles now available. However, when sufficient flows exist, spawning cui-ui have been found in the lower 26.7 miles of the Truckee River (Reclamation 2011j). Cui-ui is federally listed as Endangered. Cui-ui are threatened by habitat alteration, such as siltation and pollution, as well as declining flow in the Truckee River.

Figure 3-12. Lahontan Cutthroat Trout at Marble Bluff Dam

LCT is native to lakes and streams throughout the Truckee and Carson river basins, and is listed federally as a Threatened species. Their presence in the area is owing to their presence in the historic Lake Lahontan (Figure 3-8). At one time, Lake Tahoe and Pyramid Lake contained large populations of LCT (Figure 3-12). Two distinct Pyramid Lake LCT spawning migrations once occurred in the Truckee River, spring run and fall run. Populations also occurred in Fallen Leaf, Cascade, Donner, Independence, and Winnemucca lakes.

Lacustrine LCT are found in self-sustaining populations in Pyramid and Summit lakes, and in Walker Lake through State and Federal hatchery programs. The Pyramid Lake Paiute Tribe also operates a LCT hatchery on reservation land. Small indigenous populations exist in Independence Lake and Independence Creek in the Truckee River Basin. The Independence Lake and Independence Creek LCT population are considered important for recovery of LCT.

Though their extent is much reduced from historic levels, LCT currently occur in 155 small tributary streams with approximately 482 miles of occupied habitat throughout their range. Fluvial LCT occur in isolated headwater streams in the Truckee, Carson, and Walker river basins, as well as in an introduced population in the Desatoya Mountains in eastern Churchill County.

Principal threats to current LCT populations in the extended study area include drought, altered stream discharge and channel morphology, degraded water quality and riparian habitats, hybridization with nonnative trout, and introduced nonnative fish (Reclamation 2011j).

Also of concern in the extended study area is the tui chub found in Dixie Valley, where it lives in pools of water supported by wells and springs fed by the area's groundwater. The USFWS has indicated that the tui chub found in Dixie Valley may warrant Federal listing, but it currently has no Federal status (BLM 2001).

Reptiles and Amphibians

Two species of concern exist in the extended study area. The northwestern pond turtle (*Actinemys maromorata marmorata*), a USFS Sensitive Species, has been documented along the Carson and Truckee rivers (Reclamation 2008), and the northern leopard frog (Rana pipiens), a USFS Sensitive Species (Reclamation 2011j). Northern leopard frogs may occur in wetland areas, river channels, and irrigation canals, although their numbers have declined since the 1970s (USFWS 1996a). Several reptile species are common in the primary study area. Amphibians that may occur within the primary study area include the western toad (*Anaxyrus boreas*), and Pacific tree frog (*Pseudacris regilla*). Bullfrogs (*Rana catesbeiana*) were introduced into Lahontan Valley in the late 1800s and, despite prolonged drought, populations appear to have remained stable in the valley along riparian areas and irrigation canals (Reclamation 2000). Bullfrogs prey extensively on native fish, amphibian, and reptiles, and present a significant factor in the decline of native species (Reclamation 2011j, Reclamation 2008).

Birds

Overall diversity and the abundance of birds have declined in the Lahontan Valley. Changes in river flow regimes coupled with growth and development in the area have eliminated desirable bird habitat throughout the area. Elimination of dense riparian thickets along the Carson River has resulted in the decline of species like the black-chinned hummingbird (*Archilochus alexandri*), willow flycatcher (*Empidonax traillii*), common yellowthroat (*Geothlypis trichas*), and yellow-breasted chat (*Icteria virens*). Additionally, surveys have shown that wetland-dependent species have been adversely affected by loss of desirable wetland habitat. At least two species of ducks, three species of shorebirds, and seven species of colony nesting or marsh birds in the Lahontan Valley have experienced declines in population or reproductive success since 1970 (USFWS 1996a, Reclamation 2000).

Species that could occur in the primary study area and that are candidates for Federal Threatened or Endangered listing are the Western yellow-billed cuckoo (*Coccyzus americanus*) and Greater sage-grouse (*Centrocercus urophasianus*). The Western yellow-billed cuckoo is a riparian species with extremely specific habitat requirements. It requires dense cottonwood or willow forested tracts of at least five acres, including a minimum of one acre of closed-canopy broadleaf forest. The Greater sage-grouse occurs in a variety of sagebrush habitats (Reclamation 2011j). Bald eagles winter in the Lahontan Valley generally between November and March (Reclamation 2011j, Reclamation 2000).

Approximately 70 species of birds use wetlands in the primary study area during migration or as breeding habitat when surface water is present. These wetlands are home to the largest breeding population of white-faced ibis (*Plegadis chihi*) in North America (Figure 3-13) (Wilds 2010). Up to 175,000 ducks, geese, and swans migrate through the valley annually, and in peak years as many as 475,000 waterfowl have been recorded in the area (Reclamation 2000). Additionally, breeding species congregate in the Lahontan Valley wetlands in large numbers (Reclamation 2011j). The number of shorebirds using the wetlands can be as high as 250,000 individuals during migration periods (Reclamation 2000).

Source: USFWS

Figure 3-13. White-Faced Ibis

The prime migratory periods for birds moving through the area are generally between August and November, and February and May of each year. As a result, approximately 430,000 acres of Lahontan Valley wetlands have been named a Globally Important Bird Area by the American Bird Conservancy (Reclamation 2011j). These primary study area wetlands have been designated as a site of international importance and are part of the Western Hemispheric Shorebird Reserve Network.

Mammals

Large predatory mammals, such as coyote and mountain lion are likely to occur in open and woodland habitats within the primary study area. Mountain lions are widely distributed and are found in most mountain ranges. They occupy a limited area of Nevada, mainly along the east side of the Sierra Nevada Range and in the Carson Range.

Sagebrush communities provide perennial habitat for larger herbivorous mammals, such as mule deer and pronghorn antelope (Reclamation 2011j).

Midsized mammals, such as weasels, badgers, striped skunks, bobcats, and kit foxes, have been observed or are likely to exist in the primary study area. Of the wetland-dependent species, mink have vanished, although they were once common. Beaver and muskrat populations occur in the lower Carson River and Newlands Project canals and drains; the muskrat population is beginning to increase after being reduced during the drought period in the late 1980s and early 1990s, and their burrowing and foraging activities have also contributed to structural problems in Project canals (Reclamation 2000).

In addition, there are many species of small mammals that are likely to occur in habitat types present in the primary study area. Black-tailed jackrabbits are common to Nevada's desert and foothills, kangaroo rats inhabit deserts and grasslands, deer mice inhabit remote, rural, and urban habitats, while white-tailed antelope squirrels are adapted to a wide variety of habitats (Reclamation 2011j). Pygmy rabbits may occur in the primary study area, as this species typically inhabits dense stands of big sagebrush growing in deep loose soils. Several bat species are known to forage for invertebrates in the primary study area and roost in its various enclosed habitats (Reclamation 2011j).

Likely Future Without-Action Conditions

Some conditions for habitat and wildlife in the primary study area and extended study area are expected to improve in the future, while others will remain static or decline. As population and urban growth continues and undeveloped lands are converted to urban uses, wildlife and plants dependent on native habitat types or on agriculture may be affected; the white-faced ibis, for example, relies on flood-irrigated agricultural lands (Reclamation 2011j).

In the primary study area, the overall quality of Lahontan Valley wetland habitat will improve in the future, as a number of organizations, led by USFWS, will acquire additional Project water rights to support wetlands at Stillwater NWR and elsewhere. USFWS's Water Rights Acquisition Program for Lahontan Valley Wetlands intends to purchase enough water rights to support a long-term average of 25,000 acres of primary wetland habitat in the Lahontan

Valley at Stillwater NWR, Carson Lake and Pasture, and the Fallon Paiute-Shoshone Indian Reservation wetlands (USFWS 1996a).

In the extended study area, habitat, water quality, and water quantity will improve for wildlife and fish along the lower Truckee River and at Pyramid Lake. Under the Desert Terminal Lakes Program, Reclamation and the cities of Reno and Sparks are restoring riparian vegetation along a critical stretch of the river below Derby Dam to improve water quality and other conditions to support the LCT, cui-ui, and other resident and migratory fish species (Reclamation 2009a). The restoration action also includes providing water to Pyramid Lake via the permanent transfer of 250 acre-feet of water annually to the lower Truckee River and Pyramid Lake. In addition, as many as 2,700 acre-feet of Truckee Division water rights, to remain as instream flows in the Truckee River, will be purchased on behalf of the Pyramid Lake Paiute Tribe under the terms of the Truckee River Water Quality Settlement Agreement with the Federal Government, the cities of Reno and Sparks, and Washoe County.

This chapter's "Socioeconomic Environment" and "Water Resources" sections and Appendix C to this report contain further explanations of the anticipated changes in land use, Project acreage and ownership, and Project demand associated with water rights acquisitions to support biological resources described above.

Cultural Resources

This section describes current conditions and likely future without-action conditions for historic, prehistoric, and ethnographic resources in the primary study area, based on assessments produced for previous studies or for environmental review documents. Where pertinent to the Study, descriptions also include the resources and conditions of the extended study area. Also described in this section are Indian Trust Assets and fish species that are culturally important to Tribes in the primary study area and extended study area.

Current Conditions

At present, cultural resources in the primary study area and extended study area include prehistoric and historic sites consisting of lithic scatters, habitation sites, artifacts and diversion structures (Reclamation 2000). The Nevada Cultural Resource Information System (NVCRIS) database identifies numerous cultural resource surveys within the primary and extended study areas. These surveys were primarily for archaeological resources. The NVCRIS database contains information through 2005 only, so any studies conducted since then are not included in this report. The NVCRIS database identified 987 cultural resources within the primary study area, and 458 cultural resources within the extended study area (Reclamation 2011j).

Historic Resources

The Newlands Project is considered historically significant for its association with the earliest federally funded Reclamation project; for its association with the primary sponsor of the Reclamation Act of 1902, Francis G. Newlands; and for providing the irrigation water that determined the development and settlement patterns of the lower Carson River Basin (Reclamation 2009a). Additionally, prehistoric places within the extended study area have also been listed on the National Register of Historic Places (NRHP) and are close in proximity to the Newlands Project.

Newlands Project The Newlands Project's NRHP status has a complex history. Derby Dam was nominated and listed as an individual historic property in 1978. There was a thematic nomination in 1981 that proposed the listing of the entire Newlands Project. Only two elements, however, were actually listed at that time, Carson Diversion Dam and Lahontan Dam and Powerplant. The remaining elements were not listed because of ambiguous boundaries, although an assumption has remained that the entire Newlands Project was, indeed, listed. In 2001, Reclamation attempted to clarify the eligibility issue of the Newlands Project and to identify criteria by which conveyance features would be eligible for inclusion in the NRHP. This evaluation led Reclamation to develop a formal Newlands Project Multiple Property Nomination in 2003, which includes a more detailed historic context. The NRHP accepted this nomination, although the only Newlands Project features actually listed on the NRHP were those structures that were previously listed. As such, although the entire Newlands Project system is generally considered eligible for listing, at this time, Project elements are still listed individually on the NRHP (Reclamation 2009a). Formally listed NRHP resources are summarized in this section.

To date, no formal eligibility determination with the Nevada State Historic Preservation Office (SHPO) concurrence has been made for the Newlands Project as a whole. Reclamation is currently consulting with SHPO on an approach to identify and document the Newlands Project as a historic district (Reclamation 2009a).

- **Lake Tahoe Dam –** This dam was individually listed on the NRHP in 1981. It was constructed between 1909 and 1913, but was not acquired by Reclamation for the Newlands Project until 1915.

- **Carson Diversion Dam –**Carson Diversion Dam was individually listed on the NRHP in 1981 as part of the thematic resource nomination for the Newlands Project. The dam is an original feature of the Newlands Project and was built between 1904 and 1905.

- **Lahontan Dam and Powerplant –** Lahontan Dam and Powerplant was listed on the NRHP in 1981 as part of the thematic resource nomination for the Newlands Project. Lahontan Dam was constructed between 1911 and 1915, as part of the Newlands Project. Due to the remote location of the dam, a hydroelectric power plant was built in association with the dam to provide power for construction activities.

- **Derby Dam –** Derby Dam was listed on the NRHP in 1978 as part of the thematic resource nomination for the Newlands Project. The dam was constructed in 1905.

Prehistoric Resources Two archaeological sites are located within or immediately adjacent to the primary study area.

- **Grimes Point Archaeological Site –** Grimes Point Archaeological Site, located east of the Project near NAS Fallon, was listed on the NRHP in 1972 and is one of the largest and most accessible petroglyph (rock art) sites in the United States (Reclamation 2011j). The U.S. Department of the Interior, Bureau of Land Management (BLM) manages the site under a memorandum of agreement signed in 1976. Grimes Point is also considered an ethnographic resource.

- **Stillwater Marsh Archaeological District –** The Stillwater Marsh Archaeological District, which is within the boundaries of Stillwater NWR, was listed on the NRHP in 1974 (Reclamation 2011j). The area is culturally significant to the Paiute, particularly the nearby Fallon Paiute-Shoshone Tribe, due to the presence of ancestral remains and its ancestral use as a location for hunting and collection, and thus is also considered an ethnographic resource. Human association with Stillwater Marsh goes back at least 12,000 years (USFWS 2002). The culture and traditions of the Cattail-eater Northern Paiutes, who lived at Stillwater and Carson Lake marshes until the late 1800s (USFWS 1996), is embodied in the area's cultural resources. Because Stillwater Marsh was such an ideal place for humans to live over the millennia, Stillwater NWR contains some of the richest cultural resources in the Great Basin.

Indian Trust Assets

Indian trust assets are legal interests in assets held in trust by the Federal Government for federally recognized Indian tribes or nations or for individual Indians. Assets are anything owned that has monetary value.

As part of previous Reclamation planning processes, two federally recognized tribes have identified Indian trust assets in the primary study area and extended study area: the Pyramid Lake Paiute Tribe and the Fallon Paiute-Shoshone Tribe, both located on tribal reservations in Nevada.

Trust resources of these tribes include land, water rights, and fish and wildlife, as incomes are derived from these resources. Both tribes are primarily concerned with regional water quality and quantity, water distribution, fish and wildlife, and wetlands. Assets of particular importance identified by the tribes are discussed below.

Pyramid Lake Paiute Tribe To protect the Pyramid Lake fishery, the Pyramid Lake Paiute Tribe maintains two hatcheries to raise LCT and cui-ui; is working cooperatively with Federal, State and private agencies to improve spawning opportunities; and seeks more inflow to Pyramid Lake, as noted previously. The tribal fishery program operates hatcheries at Sutcliffe and Numana. LCT hatcheries support a world-class fishery at Pyramid Lake that generates revenue for the tribe. The cui-ui hatchery is a “fail-safe” operation to ensure the species is maintained (Reclamation 2000).

The tribe uses a portion of the interest from the principle of the Pyramid Lake Paiute Fisheries Fund, provided under Public Law 101-618, for management of the Pyramid Lake fishery. As part of endangered and threatened species recovery efforts, the Federal Government, in consultation and coordination with the tribe, is pursuing actions for rehabilitating lower Truckee River riparian habitat to enhance fish passage and spawning (Reclamation 2009a). Marble Bluff Dam has already been improved for fish passage and feasibility studies are underway for improving passage at Pyramid Lake. Along with conserving the fish, the tribe manages and controls fishing and hunting rights on the reservation.

Fallon Paiute-Shoshone Tribe The Fallon Paiute-Shoshone Tribe recognizes the importance of wetlands and the habitat they offer to birds and other wildlife. The tribe has dedicated tribal acreages for wetlands, which are served by the Newlands Project (Reclamation 2000). In addition, the tribe has expressed concern and a desire to manage the archaeologically sensitive area in Stillwater Marsh. These lands were part of the original 31,000 acres allotted to the tribe by the Federal Government. The area is of cultural significance to the tribe and represents the potential for economic and recreational development that would benefit tribal members (Reclamation 2000).

Culturally Important Species

As discussed in the biological environment section, there are two fish species occurring in the extended study area that are of cultural importance to nearby tribes (Reclamation 2011j).

Cui-ui Cui-ui is currently found only in Pyramid Lake. Beginning in the 20th century, changes in river discharge patterns due to construction of upstream storage reservoirs and increased water diversions for municipal and industrial and agricultural uses reduced Truckee River inflow to Pyramid and Winnemucca lakes. By 1967 Pyramid Lake’s surface elevation was nearly 80 feet lower than in 1900. This caused a dramatic decline in the cui-ui population. As a consequence, the species was classified as federally endangered in 1967 (Reclamation 2000).

Cui-ui was once a major food source for the Pyramid Lake Paiute Tribe, and the tribe has historically referred to themselves as Cui-ui Ticutta, meaning “cui-ui eaters.” Due to the endangered species status, the tribe has enforced a moratorium on fishing for cui-ui for nearly 3 decades. Preliminary results of recent studies indicate that the number of cui-ui adults has increased substantially due to management efforts that have included dedication of Stampede Reservoir storage to cui-ui and regulation of diversions to the Newlands Project over the last few decades as a result of OCAP (Reclamation 2000).

Lahontan Cutthroat Trout LCT is a native salmonid historically found throughout the Truckee and Carson river basins. Its presence throughout much of this area is attributable to the geographic extent of historic Lake Lahontan, shown in Figure 3-8. The largest populations of LCT occurred in Pyramid Lake and Lake Tahoe, where the fish was a major food source for local Indian Tribes. The Lake Tahoe LCT fishery disappeared in 1939 as a result of the combined effects of over-fishing, exotic fish introductions, and damage to spawning habitat. By 1944, the original Pyramid Lake LCT population was extirpated by a combination of Truckee River diversions, pollution, commercial harvest, and exotic fish introductions into the main Truckee River system. USFWS classified LCT as endangered in 1970 and subsequently reclassified it as threatened in 1975 to facilitate management and allow regulated fishing on Tribal lands and elsewhere (Reclamation 2000).

Likely Future Without-Action Conditions

Cultural resources conditions in the primary study area are unlikely to change considerably in the future. Although no specific changes are known or anticipated for the future, general trends in the primary study area, such as regional population growth and urban development, will continue to affect cultural resources and cultural landscapes through loss or disturbance of resources that are not protected, changes in setting, pressure from incremental use, and access leading to vandalism of cultural resources (Reclamation 2011j). Historic properties next to areas of growth and development are most susceptible to future impacts.

Indian trust assets and culturally important species to the region’s tribes will continue to be considered when undertaking projects in the primary study area and extended study area. Members of tribal communities will continue to seek opportunities to protect the cultural and natural resources that support their traditional spiritual connections to the primary study area and the extended study area.

Socioeconomic Environment

This section describes the current conditions and likely future without-action conditions related to the socioeconomic environment in the study area, with specific attention paid to the population and land uses that are related to the Project. The section focuses on the primary study area, but also includes the extended study area where relevant.

Current Conditions

Socioeconomic environment describes how people live and work within the study area. This includes population growth and size, industries and employment, agricultural production and practices, land uses, recreation, and public health and safety.

Population and Demographics

The majority of the primary study area is within Churchill County, but a small portion of the area is in Lyon, Storey, and Washoe counties, as shown in Figure 3-14. Population centers within the primary study area include the communities of Fernley in Lyon County and Fallon in Churchill County. Wadsworth, in Washoe County, is adjacent to the primary study area, as is the Lyon County community of Silver Springs on the western edge of Lahontan Reservoir. Of the communities within the primary study area, only Fallon and Fernley are incorporated as cities.

For the Project's Carson Division, data are included for Churchill County; this information includes the City of Fallon, which is the county seat and near the heart of the Newlands Project. City-level data are appropriate for use in describing the Fernley area, which is roughly equivalent to the majority of Project lands in the Truckee Division. The remainder of lands in the Truckee Division exist in the unincorporated Churchill County communities of Hazen and Swingle Bench, and the county-level data capture information about residents in these locations.

Many areas in Nevada experienced rapid population growth during the 2000s. Between 2000 and 2010, Fernley experienced a boom in growth, with the population increasing by 121.3 percent (U.S. Census Bureau 2012a). The community of Fernley first incorporated as a city in 2001. Many new housing developments occupied space previously dedicated to agricultural uses. Currently, Fernley makes up about 35 percent of Lyon County's population (U.S. Census Bureau 2012b). Although Churchill County's population only increased by 4 percent between 2000 and 2010, its largest city, Fallon, grew by an estimated 14 percent (U.S. Census Bureau 2012c, d). Currently, Fallon residents make up approximately one-third of Churchill County's population.

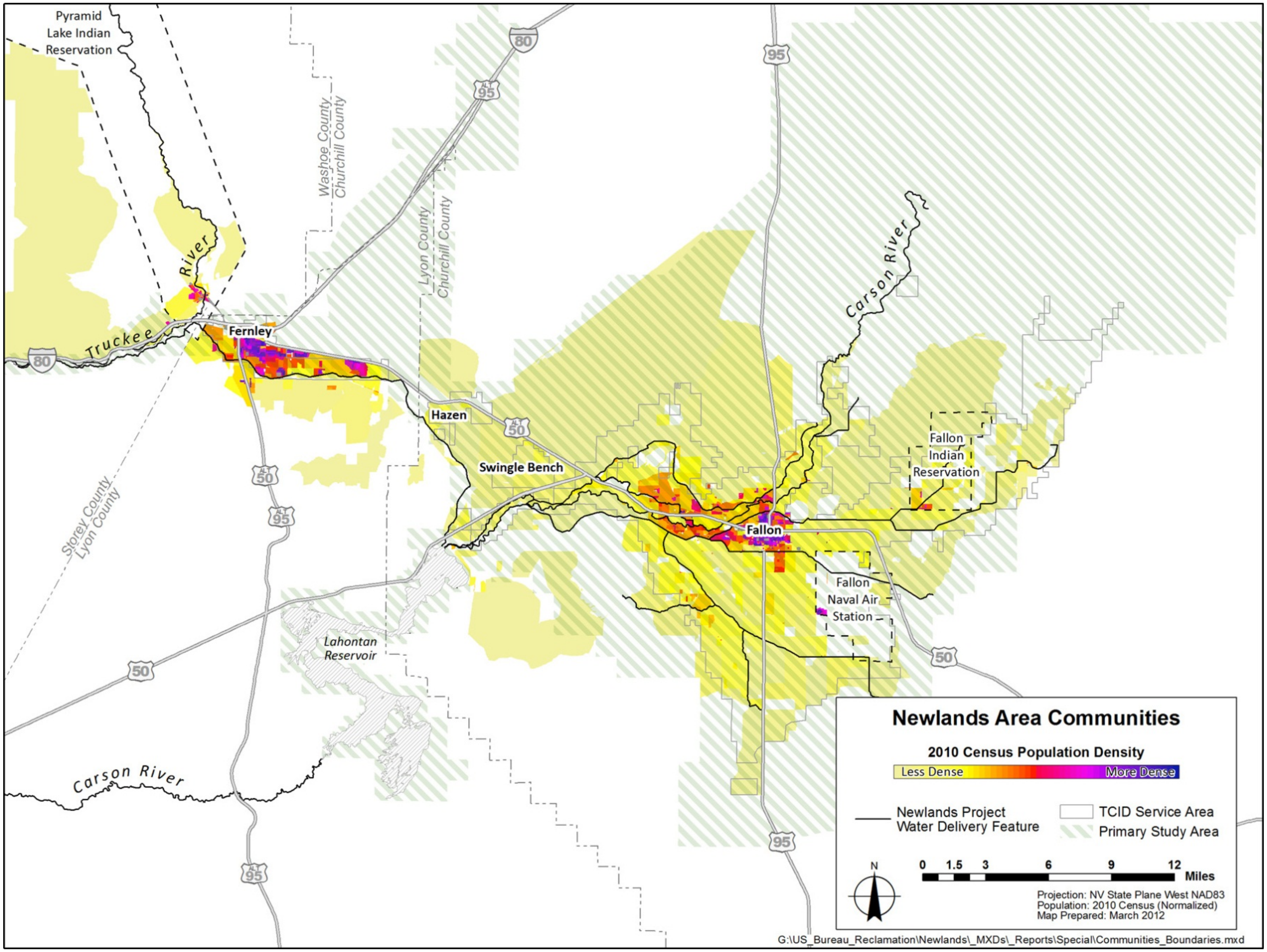


Figure 3-14. Map of Communities and Political Boundaries in the Primary Study Area

Fernley's population was estimated to be approximately 18,378 people (residing in 6,463 households) in 2010 (Table 3-5) (U.S. Census Bureau 2010a). Median household income in Fernley was $53,346, and median family income was $61,153. Both measures are higher than Nevada's statewide averages. Per capita income was $21,581, which is slightly lower than the State average of $27,589 (U.S. Census Bureau 2010b). Nine percent of the population and 8 percent of families lived below the poverty line.

Churchill County's population was estimated to be approximately 24,946 people (residing in 8,801 households), in 2010 (Table 3-5) (U.S. Census Bureau 2010c). Median household income in the county was $51,597, and median family income was $63,599. Per capita personal income for the county was $22,997. Nearly 9 percent of the population and 7 percent of families lived below the poverty line.

Table 3-5. Population and Housing Demographics for Communities in the Primary Study Area

	Fernley, Nevada	Churchill County, Nevada
Population	18,378	24,946
Housing Units	7,710	10,775
Households	6,463	8,801
Average Household Size	2.84	2.80
Average Family Size	3.44	3.60
Median Household Income	$53,346	$51,597
Median Family Income	$61,153	$63,599
Per Capita Income	$21,581	$22,997
% of Population Below Poverty Line	9.2	8.8
% of Families Below Poverty Line	8.1	6.8

Source: 2006-2010 American Community Survey 5-Year Estimates for Fernley city and Churchill County, Nevada (U.S. Census Bureau 2010a, c)

Economic Activity and Employment

In the primary study area, economic conditions and employment largely mirror Nevada's broader trends or conditions statewide. Table 3-6 provides basic data on employment in the primary study area's communities and in Nevada overall.

Table 3-6. Comparison of Unemployment Rates in the Primary Study Area and Statewide

	Unemployment Rate
Fernley, Nevada (Micropolitan Statistical Area)	17.5%
Churchill County, Nevada	11%
Statewide, Nevada	13%

Source: BLS 2012a, b

Note: Micropolitan Statistical Areas are larger, geographically, than city boundaries.

Fernley As of 2010, 18 percent of Fernley's civilian work force was employed in retail trade and about 13 percent in manufacturing (U.S. Census Bureau 2010a). Eleven percent work in each of transportation and warehousing; educational services, health care, or social services; and arts, entertainment, recreation, accommodation, or food services. The number of people employed directly in agriculture is relatively small – at most, 0.6 percent of the labor force.

Churchill County As of 2010, 15 percent of Churchill County's civilian work force was employed in arts/entertainment/recreation/accommodation/food services (U.S. Census Bureau 2010b). About 14 percent work in education, health care, and social services and 12 percent work in retail trade. Six percent work in agricultural and mining occupations. Over 21 percent of the work force are classified as government workers, and nearly 4 percent of the total labor force is part of the armed forces.

NAS Fallon is a key component of the local economy. As of 2006, NAS Fallon base population is about 3,000 active duty and civilian DOD personnel (NDEP 2006). Collectively, employment of Federal personnel and civilian contractors provided about $257.6 million of output for the county, about 20 percent of total county output in 2000 (Reclamation 2005).

Table 3-7 summarizes employment by industry in the primary study area.

Table 3-7. Employment by Industry in the Primary Study Area

Industry	Fernley, Nevada	Churchill County, Nevada
Agriculture, forestry, fishing and hunting, and mining	0.6%	6.0%
Arts, entertainment, and recreation, and accommodation and food services	10.9%	14.9%
Construction	8.0%	7.9%
Educational services, and health care and social assistance	10.9%	13.7%
Finance and insurance, and real estate and rental and leasing	4.4%	4.3%
Information	3.3%	1.4%
Manufacturing	12.5%	7.1%
Other services, except public administration	3.7%	5.0%
Professional, scientific, and management, and administrative and waste management services	7.7%	8.9%
Public administration	5.1%	9.0%
Retail trade	18.2%	11.9%
Transportation and warehousing, and utilities	10.7%	7.6%
Wholesale trade	4.0%	2.3%

Source: 2006-2010 American Community Survey 5-Year Estimates for Fernley city and Churchill County, Nevada (U.S. Census Bureau 2010a, b)

As of 2000, agricultural production contributed approximately $60 million annually to the Churchill County economy (Reclamation 2005). In terms of both output and employment, the biggest agricultural sectors were dairy, range cattle, and hay and pasture; collectively, these three sectors produced $45.08 million in product each year. Dairy farms in the county generated about $23.24 million. Hay and pasture produced approximately $13.23 million in annual sales. Ranch-fed cattle generated $8.61 million of output.

Agriculture

Although agriculture is a relatively small component of the primary study area's regional economy, it is closely linked to the region's history and remains a commercially and culturally important enterprise. Because virtually all of the agricultural production in the primary study area is supported by the Newlands Project, this section focuses primarily on agricultural activities on Project lands.

Newlands Project Of the irrigated Project lands, 48,729 acres are dedicated to agriculture; 95 percent are in the Carson Division and 5 percent are in the Truckee Division. This Study only considers 63,596 acres of these original water rights to be active or to have the potential to be active; the remainder have been forfeited, retired, or identified for future retirement (see Appendix C, "Projected Future Water Rights and Demands for the Newlands Project").

While much of the Project land is devoted to irrigated agriculture in the production of hay and forage crops, there are a variety of land-use trends affecting the proportion of actively irrigated land in both the Truckee and Carson divisions. These include USFWS's Water Rights Acquisition Program for Lahontan Valley Wetlands in the Carson Division, the Newlands Project Water Rights Compensation Program, and efforts by Fernley and the Pyramid Lake Paiute Tribe to dedicate Truckee Division water rights for municipal and environmental uses, respectively.

The Project delivers water to 635 customers with water rights ranging in size from small residential gardens of less than 1 acre to USFWS's nearly 9,000 water-righted acres (TCID 2010a). In terms of distribution of water-righted acreage, three-quarters of the Project's individual rights are appurtenant to parcels of less than 10 acres in size; 6 percent to parcels between 50 and 100 acres in size, and approximately 3 percent to parcels larger than 100 acres. To lend some perspective to this breakdown, it should be noted that water rights with more than 100 acres comprise 53 percent of all water rights within the Project. The distribution of water right acres within the Project is noted below in Table 3-8.

Table 3-8. Distribution of Water Rights in the Newlands Project

Water Right Size (Acres)	Carson Division		Truckee Division		Total Newlands Project			
	Individual Rights	Total Acres	Individual Rights	Total Acres	Individual Rights	Proportion of Individual Rights	Total Acres	Proportion of Total Acreage
0 – 10	1,483	4,168	897	1,233	2,380	74%	5,401	8%
10 – 50	523	13,206	34	803	557	17%	14,009	21%
50 – 100	176	12,101	5	322	181	6%	12,423	18%
100 – 500	94	17,923	1	260	95	3%	18,183	27%
500+	9	17,646	0	0	9	0%	17,646	26%

Notes:
Individual rights were compiled from TCID water rights records (see Appendix C). Rights that have been identified as inactive or retired are not included in the data. TCID records are known to include over 1,300 acres of rights that are inactive and will eventually be retired by the Water Rights Compensation Program, and over 2,400 acres that are excluded from use by the Fallon Paiute-Shoshone Tribe, all within the Carson Division. Specific rights for these known inactive acreages are not identified within the TCID records and thus could not be omitted from the data presented here.
Multiple individual rights may be owned and/or managed by a single entity. Consolidated ownership of multiple individual rights is not reflected.
Key:
TCID = Truckee-Carson Irrigation District

Data in Table 3-8 contain both active acreages of water rights and acreages of water rights that are known to be inactive, but have not been specifically identified as such within TCID water rights records. The Study performed an analysis of current water rights that adjusts for the amount of acreage known to be inactive. This analysis is described in Appendix C ("Projected Future Water Rights and Demands for the Newlands Project"), and the resulting assessment of current water rights is summarized in Table 3-9.

Table 3-9. Summary of Current Newlands Project Water-Righted Acres by Type of Use[1]

Purpose or Use	Active and Potentially Active Acres		Inactive or Retired Acres[2]	Total Acres
	Carson Division	Truckee Division		
Agricultural	46,428	2,301	1,363	50,092
Wetlands/Environmental	11,810[3]		5,478[4]	17,288
Municipal and Industrial	766	2,292		3,058
Ineligible or Forfeited[5]			3,237	3,237
Total	**59,003**	**4,593**	**10,079**	**73,675**

Notes:
[1] Figures have been rounded to their whole-number equivalents; as a result, some rounding errors may exist.
[2] Water rights appurtenant to inactive or retired acres cannot be exercised now or in the future. Inactive and retired rights are treated as if they have no demand (zero acre-feet) in all analyses performed by the Study.
[3] USFWS/Stillwater NWR 8,939 acres, Carson Lake and Pasture 2,403 acres, and Fallon Paiute-Shoshone tribal wetlands 468 acres.
[4] AB 380 program 4,436 acres, Water Rights Compensation Program 66 acres, and Water Quality Settlement Agreement 976 acres.
[5] Water rights forfeited by court order, acquired by USFWS but which cannot be transferred to Stillwater NWR, or held by the Fallon Paiute-Shoshone Tribe but which exceed the cap in Public Law 101-618.

Key:
AB = Assembly Bill
USFWS = U.S. Fish and Wildlife Service
NWR = National Wildlife Refuge

Irrigated alfalfa is the dominant crop grown in the primary study area, but other crops produced include wheat, corn, barley, and vegetables, as shown in Table 3-10. Cattle ranching and dairy production are the primary livestock agricultural activities. While a large percentage of the area's forage crops are used to feed beef cattle at major commercial feed lots and on individual farms, a considerable amount of hay is also exported from the immediate area (Reclamation 1988).

Table 3-10. Summary of Crop Types and Irrigation Methods in the Newlands Project

	Carson Division	Truckee Division
Crop Type		
Alfalfa	67%	62%
Other Hay	4%	10%
Pasture	15%	26%
Other (corn/sudan, small grains, and vegetables)	14%	1%
Irrigation Method		
Flood	99%	
Furrow	1%	
Other	<1%	

Source: NASS 2011, TCID 2010a

Most of the irrigation occurs through flood methods, which is the traditional method for irrigating alfalfa. Alfalfa is the crop predominantly cultivated in the Project, particularly due to favorable climate, ability to store the crop, relatively stable and certain yields, ease of transportation, and market viability. While other crops have been grown in the Lahontan Valley, alfalfa has been the most reliable and widespread crop cultivated. "Hearts O' Gold" cantaloupes were extensively grown in the Project during the 1920s and 1930s, but weather-related conditions posed a frequent threat to the crops, and fruit often split while being shipped around the country; other fruit and beets have also been grown in the Project in past decades.

According to a report published by the University of Nevada, Reno (Darden et. al. 1999), as of 2000, the Newlands Project generated about $58 million in agricultural output (dairy, livestock, feed grains, alfalfa, other hay, and other cultivated crops); cultivated agriculture represented about 46 percent of this total (Reclamation 2000).

Non-Project Agriculture Several areas of agricultural production in the extended study area are also important to note for the purposes of this Study. Long before the arrival of the U.S. Reclamation Service (USRS), the precursor to Reclamation, settlers in the extended study area began creating irrigation ditches. As early as 1863, hay ranches were established in Truckee Meadows and Lahontan Valley (U.S. et al. 2008). Settlers in the lower Carson River Basin initially fed cattle driven from Texas or California on native hay and sold both the cattle and hay to Comstock residents.

Currently, the Truckee Meadows area near Reno-Sparks includes approximately 2,125 acres of land irrigated for commercial purposes (NASS 2011). Adjacent to the primary study area, there are approximately 1,668 irrigated acres between Derby Dam and Pyramid Lake, the majority of which are located within the Pyramid Lake Indian Reservation (Reclamation 2000). Approximately 1,200 acres of food and forage crops are irrigated by the Carson River between Dayton, approximately 22 miles southwest of the reservoir, and the Lahontan Reservoir, on the west side of the primary study area (Reclamation 2011j).

Land Use and Management

Approximately two-thirds of the primary study area lands are federally owned. Reclamation manages Newlands Project withdrawn lands and has entered into several partnerships and agreements with other agencies to manage the lands subordinate to the Project's authorized purposes of irrigation, agriculture, and wetlands. The rest of the land in the primary study area is used mainly for farming, ranching, urban development, industrial enterprises, and transportation. Land uses in surrounding areas include tribal lands, DOD facilities, energy and mineral development, and recreation. Several of these are described below; agriculture and recreation are addressed in separate sections of this chapter.

The Railroad Act of 1862 has influenced part of the ownership pattern in the primary study area. Under the Railroad Act, the Federal Government gave the railroad company 10 square miles of land for each mile of track that was completed (NPS 2005). The Railroad Act granted to the railroad every other square-mile section in 20 miles each side of the railroad centerline. This act created a "checkerboard" ownership pattern of alternating private and Federal land parallel to the railroad right-of-way.

Tribal Lands Currently in the primary study area, the Fallon Paiute-Shoshone Tribe holds 8,020 acres of allotted and tribal trust lands in the Lahontan Valley (Reclamation 2000). A large portion of the land, 5,440 acres is appurtenant to Newlands Project water rights, although Public Law 101-618 limits irrigation to 3,025 of those acres. Some of these lands are owned by the tribe, and others are owned by individuals. The tribe has dedicated approximately 468 acres to sustain wetlands.

The Pyramid Lake Indian Reservation occupies approximately 475,085 acres, the majority of which are within the Truckee River Basin in the extended study area (Reclamation 2000).

Wetlands and Wildlife As noted in Chapter 1, there are multiple wildlife refuges within and adjacent to the primary study area, including the Stillwater NWR and the Fallon NWR. Stillwater NWR occupies approximately 124 square miles (about 77,000 acres) in the Lahontan Valley at the northeasternmost edge of the Project and is classified as a Site of International Importance by the Western Hemispheric Shorebird Reserve Network due to the hundreds of thousands of shorebirds that migrate through. USFWS also owns water-righted acres in the Project and is the single largest user of Project water. The Fallon NWR is located in the Lahontan Valley near the terminus of the Carson River.

The State of Nevada manages both the Fernley Wildlife Management Area and Carson Lake and Pasture. The Fernley Wildlife Management Area, north of the city of Fernley, provides protection of wetlands and waterfowl habitat in addition to providing hunting opportunities. Carson Lake and Pasture includes 10,800 acres of wetlands and is located 8 miles southeast of Fallon (Richard Grimes, USFWS, personal communication, April 18, 2012). Carson Lake and Pasture is primarily managed for wildlife, habitat, and public use, though a portion of its lands are permitted for grazing; as with Stillwater NWR, it is a recipient of Project water.

Defense The NAS Fallon Main Station occupies 8,583 acres in Churchill County and includes an airfield, industrial facilities for maintaining aircraft and support equipment, business facilities, retail and recreation facilities, housing, and utilities, and is surrounded by agricultural and vacant lands that serve as a safety and noise barrier (NDEP 2006). NAS Fallon training and bombing ranges use an additional 241,338 acres, including more than 78,000 in Dixie Valley within the extended study area (BLM 2001). Bravo-16, the bombing and training range closest to the primary study area, occupies approximately 17,280 acres southwest of Fallon (NDEP 2012).

Energy and Mineral Development The potential for energy production, including solar, wind, biomass, geothermal, hydroelectric, oil, and gas resources, have been investigated in the primary study area and extended study area. Of these energy resource types, only geothermal resources are currently under development and are managed as leasable minerals (Reclamation 2011j). Two geothermal plants were constructed in the Lahontan Valley in the 1970s and are still operational. Geothermal energy production is also discussed in the “Infrastructure” section of this chapter.

Dixie Valley, in the extended study area, has been a proposed location for procurement of additional water sources for the Project. Current land uses for Dixie Valley include water production for Navy purposes, Navy air warfare training activities, geothermal energy production, and irrigation. Approximately 19,700 acre-feet of committed underground water rights are held by the Navy or committed to geothermal leases in Dixie Valley.

Public Health and Safety

This section is a discussion of public health and safety concerns within the primary study area that are related to or affected by the Project.

Truckee Canal As evidenced by the 2008 canal breach and flood in Fernley, operation of the Truckee Canal presents risks to public safety in the increasingly urbanized areas through which the structure passes. As described in the "Infrastructure" and "Water Resources" sections, these risks have been investigated by Reclamation, and identified corrective actions will be included as part of this Study.

Hazen Domestic Water Supply Following a November 2010 dewatering of the Truckee Canal, the community of Hazen found that they were unable to obtain supplies for their reservoir. There are indications that the community was diverting water from the Hazen Pipeline, connected to the Truckee Canal, and that this water was being used for household purposes (Reclamation 2011k). Household uses of water diverted from the Truckee Canal pose public safety concerns as water diverted from the Truckee Canal is required to undergo a minimum treatment level to become potable water, per Nevada drinking water quality regulations. Water diverted at the Hazen Pipeline had not gone through the minimum treatment and thus was not considered to be potable water suitable for household use. Investigations indicated that the community of Hazen most likely did not have a valid water right for this water, and TCID sealed the pipe at Reclamation's direction in May 2011.

Hazardous Materials The Carson River Mercury Superfund Site consists of sediments in an approximately 50-mile stretch of the Carson River in Lyon and Churchill counties, beginning between Carson City and Dayton, Nevada, and extending downstream through the Lahontan Reservoir to Stillwater NWR. This site also includes tailing piles associated with the river (EPA 2007).

Recreation and Public Access

The study area offers a large array of aquatic- and land-based recreation opportunities. Most outdoor recreation occurs on public lands under the jurisdiction of the BLM, Reclamation, USFWS, Nevada State Parks, or NDOW. The principal recreational use areas are Lahontan Reservoir State Park, Stillwater NWR, Carson Lake and Pasture, and Fort Churchill State Park, although recreation also occurs at Newlands Project regulating reservoirs, Soda and Indian lakes, and areas along the Carson and Truckee rivers.

Recreational opportunities are also available in the extended study area, most notably at Pyramid Lake and along the Truckee River. The Pyramid Lake Paiute Tribe manages lake-based recreational opportunities at Pyramid Lake. The Truckee River is a popular location for stream-based recreation, such as fishing, kayaking, and commercial rafting activities, and for picnicking.

Recreation at Newlands Project Facilities Lahontan Reservoir is the largest body of water in Lahontan Valley and provides opportunities for boating, fishing, and camping. Lands surrounding the reservoir are under the jurisdiction of Reclamation, but have been managed by Nevada State Parks as a park since

1971 (USFWS 1996a) under a memorandum of understanding signed by Reclamation, TCID, and the State of Nevada.

Aquatic recreational opportunities at the Lahontan State Recreation Area include fishing, boating, water skiing, and swimming (Nevada Division of State Parks 1991). The water-based recreation season at Lahontan Reservoir lasts approximately 6 months, with the bulk of annual visitation between May and August. July is a particularly important month for recreational visitation at Lahontan Reservoir, with as much as 25 percent of annual visits occurring during that month (U.S. Department of the Interior 1997).

Seventy percent of visits to Nevada's District III parks (which includes Rye Patch Reservoir, Walker Lake, Fort Churchill, Belmont, and Berlin-Ichthyosaur State Park) occur at Lahontan State Recreation Area. The facility is the heaviest-used camping and boating park in the State system due, in part, to its proximity to the urban areas of Reno and Carson City (U.S. Department of the Interior 1997).

Recreational use of Lahontan Reservoir is strongly tied to water level. Annual visitation to the reservoir can approach 500,000 people during average and above-average water years, but declines substantially in years when water levels are low. According to the Nevada Division of State Parks, a storage volume of 150,000 acre-feet (water elevation 4144.9 feet) is preferred during July, the most important month for recreation at Lahontan Reservoir. A volume of 120,000 acre-feet (water elevation 4139.5 feet) is the minimum water volume for reasonable use of boat ramps at the reservoir, and below 90,000 acre-feet (water elevation 4133.3 feet), virtually no power boat use is possible (USFWS 1996a). Land-based recreation at the Lahontan State Recreation Area consists of picnicking, camping, hunting, target shooting, hunting dog trials, fishing, and use of radio-controlled boats or planes (Nevada State Parks 2007). Camping opportunities include both developed and undeveloped sites (Nevada State Parks 2007). Newlands Project regulating reservoirs include Harmon, Sheckler, S-Line, and Old River. Recreation is a secondary use of these reservoirs and is not specifically authorized as a function of the Newlands Project.

Recreation at Study Area Wetlands Recreation opportunities in study area wetlands include waterfowl hunting, bird-watching, sightseeing, camping, and other activities.

Hunting is permitted at Stillwater NWR, Fernley Wildlife Management Area, and Carson Lake and Pasture. Camping is also permitted at Stillwater NWR and Fernley Wildlife Management Area. Fernley Wildlife Management Area, north of Fernley, is managed by NDOW under an agreement signed by Reclamation, TCID, and the State of Nevada (U.S. et al. 2008).

An average of almost 39,000 people annually visited Stillwater NWR and Wildlife Management Area from 1994 to 1998. Of these visitors, about half were there for general recreation such as bird-watching and sightseeing. Day-use of facilities predominated and the vast majority of visitors (about 84 percent) were Fallon-area residents (USFWS 1996a). Most non-local visitors engaged in bird-watching (approximately 80 percent) originated in the Reno/Sparks area (Englin et al. 1999).

A study conducted in the Fallon area calculated average expenditures for wetlands-based recreational activities to range from $21 per person per trip for general recreationists to $38 per person, per trip for hunters (Englin et al. 1999). Based on these figures, and adjustments for inflation, and the numbers of visitors, total recreation expenditures could range from $850,000 to $2.38 million annually.

Non-Facility Land-Based Recreation Land-based recreation that occurs within the study area includes walking, hiking, horseback riding, picnicking, camping, hunting, wildlife viewing, and off-road vehicle use, which is restricted on Federal lands but does occur illegally.

Likely Future Without-Action Conditions

Based on projections conducted by the Nevada State Demographer's Office both Lyon and Churchill counties are projected to continue to experience growth from 2009 to 2030 (overall growth of 2.3 percent and 0.8 percent, respectively) (Nevada State Demographer's Office 2010).

In general, the primary study area is likely to see an overall reduction in agricultural production in response to various existing programs or efforts to acquire and/or retire Newlands Project water rights in both the Truckee and Carson divisions. In the Carson Division, the result of these trends is a reduction in agriculture and an overall shift in water use that increases Project water deliveries to the Lahontan Valley wetlands. Truckee Division agriculture is expected to decrease by nearly 40 percent, with corresponding increases in demand for municipal and environmental uses. These shifts in the Truckee Division will be driven by dedications of water rights to the City of Fernley for M&I purposes, and on behalf of the Pyramid Lake Paiute Tribe for the Water Quality Settlement Agreement (Tables 3-11 and 3-12). Smaller, non-commercial farms within the Truckee Division, which have less intense water needs and are also likely to be less reliant on the commercial value of the products they produce, are expected to remain in operation and continue to require water deliveries.

Table 3-11. Summary of Projected Future Acquisitions of Water-Righted Project Land

Program	Intended Use	Water Rights Acquired	
		Acres	Source
USFWS Water Rights Acquisition Program	Wetlands (acres eligible for use)	12,064	Carson Division Irrigation Rights
	Wetlands (acres ineligible for use but acquired with eligible acres)	534	Carson Division Irrigation Rights
Water Rights Compensation Program	Retire	779	Inactive Carson Division Rights
		50	Inactive Truckee Division Rights
WQSA	Remove from Project	600	Truckee Division Irrigation Rights
City of Fernley	M&I	250	Truckee Division Irrigation Rights

Key:
M&I = municipal and industrial
USFWS = U.S. Fish and Wildlife Service
WQSA = Water Quality Settlement Agreement

Table 3-12. Projected Changes in Potentially Active Newlands Project Water Rights[1]

		Current (acres)	Future (acres)	Change	
				(αχρεσ)	(αχρε–φεετ)
Carson Division	Ag	46,428	34,363	-12,064	-42,500
	M&I	766	766	-	-
	Env	11,810	23,874	+12,064	+36,072
Truckee Division	Ag	2,301	1,451	-850	-3,825
	M&I	2,292	2,542	+250	+1,125
TOTAL		**63,597**	**62,996**	**-600**	**-9,128**

Note:
[1] Figures have been rounded to their whole-number equivalents; as a result, some rounding errors may exist.

Key:
Ag = Agricultural
Env = Environmental
M&I = municipal and industrial

Key Study Assumptions

Overall, 14,277 acres of water-righted Project land is expected to change hands in the future, and will variously be retired or applied to a new use within the Project. The total acreage of potentially active Project water rights will decrease from 63,597 to 62,996 acres – about 1 percent of the current acreage.

In the Truckee Division, 600 acres of active or potentially active water rights for irrigation will be permanently retired from Project use. Another 250 acres of potentially active water rights for Truckee Division irrigation will be dedicated to M&I use. In the Carson Division, 12,064 acres of active or potentially active water rights for irrigation will be purchased by USFWS to support wetlands at Stillwater NWR. Appendix C ("Projected Future Water Rights and Demands for the Newlands Project") contains an explanation of the analyses completed to support these assumptions.

Water Resources

This section describes the current conditions and likely future without-action conditions related to the water resources in the primary study area, and how these are managed and used. Where pertinent to the Study, descriptions also include the resources and conditions of the extended study area.

Current Conditions

The description of the water resources in the primary study area focuses on surface water and hydrology, ground water, water quality, and water use and management.

Surface Water and Hydrology

Lake Tahoe's outlet is the source of approximately one-third of the Truckee River's flow; the remaining two-thirds derive equally from sidewater and controlled tributaries to the river. Average annual net inflow to Lake Tahoe is 180,400 acre-feet. From Lake Tahoe, the Truckee River flows generally north and east through California for about 40 miles and enters Nevada near the town of Farad, California. The main tributaries are Donner, Martis, and Prosser creeks and the Little Truckee River, all of which are regulated by dams. The unregulated drainage area produces 30 percent of the average annual runoff at Farad. Historic annual discharge of the Truckee River at Farad ranges from a low of 133,460 acre-feet in 1931 to a high of 1,768,980 acre-feet in 1983. Average annual discharge at Farad is 561,800 acre-feet (Reclamation et al. 2008). The Truckee River flows another 80 miles from Farad to Pyramid Lake. The main Nevada tributary is Steamboat Creek. A portion of Truckee River flow is diverted at Derby Dam into the Truckee Canal. Streamgage records for the Truckee River upstream from Derby Dam near Vista, Nevada, show an average annual flow of 538,700 acre-feet during the period from 1901 to 2010 (USGS 2012b).

The east and west forks of the Carson River originate in Alpine County, California, and enter Nevada near the Carson Valley in Douglas County, where groundwater flow becomes a significant mode of flow transport in the valley (Tracy and Unger 2008). Historic annual discharge of the Carson River to Lahontan Reservoir (measured at Fort Churchill) ranges from a high of 804,600 acre-feet in 1983 to a low of 26,260 acre-feet in 1977. Average annual discharge to Lahontan Reservoir was 276,000 acre-feet per year for the period of 1911 to 2000 (Reclamation et al. 2008). Lahontan Reservoir is located on the Carson River about 18 miles west of Fallon, Nevada, and impounds Carson River's flow. Lahontan Reservoir is the only large reservoir on the Carson River and is the only point at which the entire river's flow can be controlled. Twenty-four small alpine reservoirs on the East Fork and West Fork of the river in the upper basin have capacities between 31 and 2,400 acre-feet, with a total combined storage of 11,766 acre-feet (CDWR 1991b).

The lower Carson River flows from Lahontan Reservoir about 50 miles through Lahontan Valley. Before construction of the Newlands Project, the river terminated in the Carson Desert (Reclamation 2011j). Development in the region has altered the course of the Carson River below Lahontan Dam. Today, several individual sinks exist within the larger closed Carson River drainage basin. One channel of the Carson River turns northward near Fallon, leading to the Carson Sink playa lake. Water now reaches this portion of the basin only in the wettest years. Another channel turns southward toward a sink area known as Carson Lake and Pasture. Historically, waters of the Carson River spread over a broad region east of Fallon, creating a series of ephemeral and perennial lakes and marshes. The Stillwater NWR area is one remnant of these earlier wetlands. Settlement and agricultural development have altered the flow patterns and amount of water reaching the remaining wetlands in the sink. When flows exceed the needs of agricultural users, the excess flows reach the Carson Lake and Pasture and Stillwater NWR.

Figure 3-15 illustrates the average annual volume of flow through the Truckee and Carson basins using hydrologic data collected from various sources for years between 1901 and 2000. The subsection below, "Surface Water Management and Use," describes the relationship between the Project and hydrologic conditions in the Truckee and Carson river basins.

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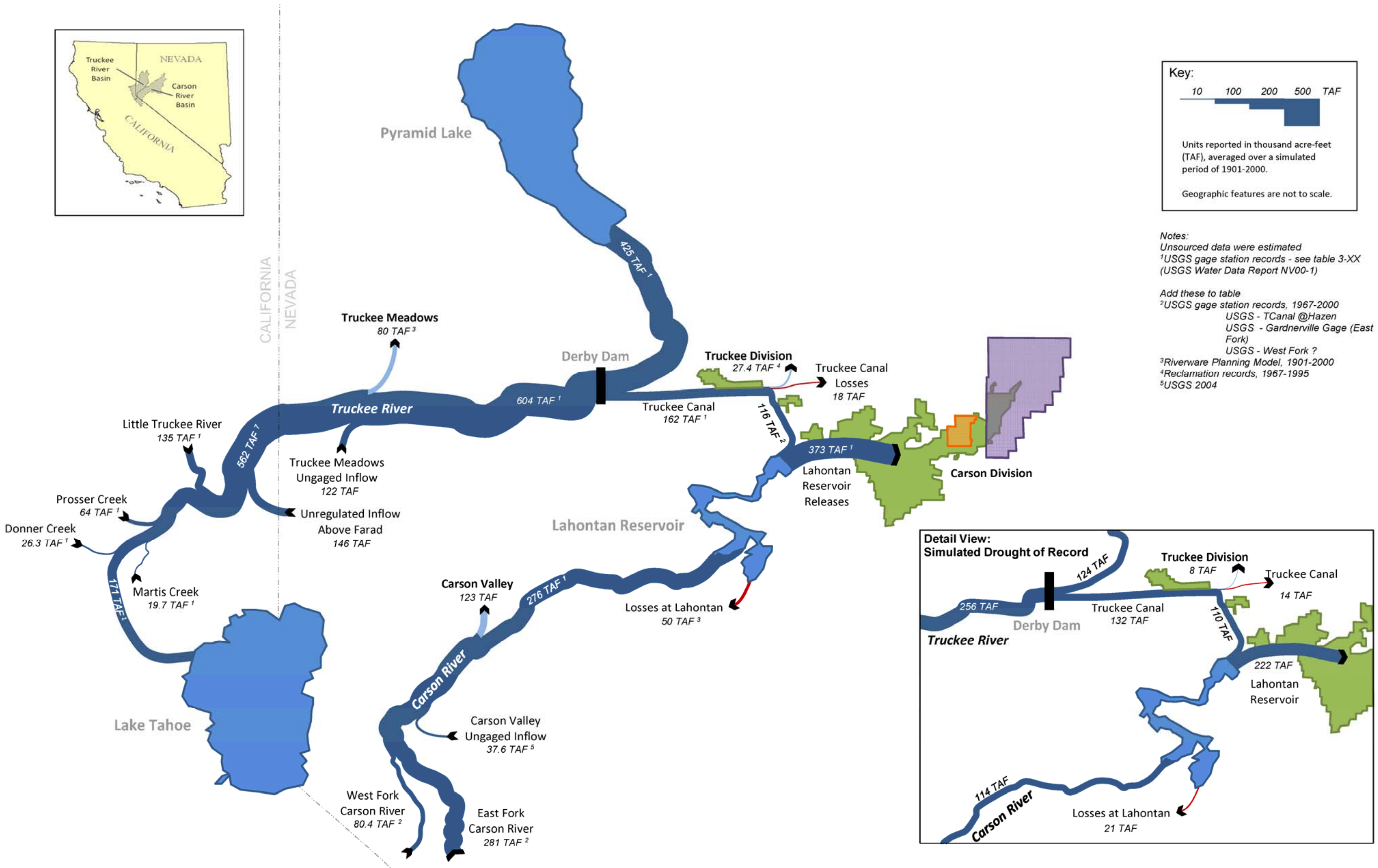

Figure 3-15. General Depiction of Average Annual Hydrologic Conditions in the Truckee and Carson River Basins

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Surface Water Management and Use

In the primary and extended study areas, spring runoff generally occurs from April to June for the Truckee and Carson rivers. The Carson River near Fort Churchill has gone dry a number of times during dry years when upstream diversions take the river's flow. The primary rules and structures for managing most of this surface water are noted in Chapter 1 of this report, but are also described below, briefly.

Truckee River water is stored in the upper watershed in Lake Tahoe, as well as in Prosser, Stampede, and Boca reservoirs. Storage is also available in two privately owned reservoirs, Donner and Independence lakes. Reclamation regulates Lake Tahoe Dam and upper basin dams to meet Floriston rates at the Farad, California, gaging station. Similar large facilities do not exist on the upper Carson River, and management of the Carson River is distinctly different from the Truckee River.

Rights to use the surface water resources described above are established in the *Orr Ditch* Decree for the Truckee River, and the *Alpine* Decree for the Carson River. Within the extended study area, upstream from the Newlands Project, Carson and Truckee water users exercise their rights to serve municipal, agricultural, and environmental purposes. In the primary study area, however, the majority of the surface water is used by the Newlands Project.

Figure 3-15 combines a number of sources of streamflow data to illustrate the average flows through the Truckee and Carson basins. The figure highlights the Newlands Project's reliance on diversions from the Truckee River for approximately 25 percent of its average annual water supply. Historically, the Project has relied upon the Truckee River for as much as 75 percent of its water deliveries.

Average conditions, however, are not the norm. While the Newlands Project relies primarily upon the Carson River for its water supplies, periods of drought result in an increased reliance upon the Truckee River. The "Drought of Record" detail view in Figure 3-15 depicts simulated operation of the Truckee Canal during the drought of record (from 1987 to 1994). This illustrates how much the Project relies upon the Truckee River (approximately 50 percent over eight years in this case) for meeting water rights deliveries during periods of prolonged drought on the Carson River. In turn, the Project has a far greater effect on overall flow in the lower Truckee River and to Pyramid Lake during prolonged droughts. The simulated operation of the Project during the drought of record resulted in an overall diversion of just over half of the Truckee River's flow at Derby Dam.

Newlands Project Operations Project operations, in their basic form, occur as follows: The portion of Truckee River water which the Project may receive is diverted into the Truckee Canal. The water is then used for irrigation in the Truckee Division and, in some years is delivered to Lahontan Reservoir. Water stored in Lahontan Reservoir is released to serve water rights holders in the Project's Carson Division. Surface water is the sole source of supply and use that is authorized for the Newlands Project; groundwater is not a source of Project supply, nor is groundwater recharge intended as a Project purpose. The aspects of Project operations most critical for this Study are those related to the Truckee Canal and to OCAP, both of which are explained below.

Truckee Canal The canal is operated by controlling diversions from the Truckee River at Derby Dam and through a number of hydraulic structures along the length of the canal to control flow. The canal is often checked up to various levels throughout the summer. During the winter months (December through March) the canal is checked up to make stockwater deliveries.

While the canal was originally designed and water righted to convey up to 1,500 cfs, the capacity intended for serving the Truckee and Carson divisions was 900 cfs. The 1,500 cfs design was needed for supplying 600 cfs for the irrigation of a planned third division (the Pyramid Division) from a siphon in the Derby Reach, approximately 6 miles downstream from Derby Dam on the Truckee Canal. The Truckee Canal capacity is reduced beyond this point, with an ending capacity of 900 cfs. Within the past few decades of operation, the canal has rarely conveyed more than 750 cfs. In the 12 hours preceding the 2008 breach, conveyance in the Truckee Canal ramped up very rapidly from about 350 cfs to around 750 cfs (Reclamation 2008b). As noted in the "Infrastructure" section above, TCID has operated the Fernley Reach of the canal at a maximum flow stage of 350 cfs since May 2008.

Administration of OCAP In addition to operations of the Truckee Canal as described above, Project operations are based on a set of rules and procedures contained in the OCAP for the Newlands Project issued by the Secretary of the Interior on December 31, 1997. In general, OCAP reflects the Federal Government's duty to support the Project water rights holders, its Indian Trust Responsibilities to the Fallon Paiute-Shoshone Tribe and Pyramid Lake Paiute Tribe, and its need to meet ESA requirements as they relate to the Truckee River and Pyramid Lake.

The main purposes of OCAP are:

- To ensure legitimate Newlands Project water rights are satisfied
- To regulate the timing and amount of water that can be diverted out of the Truckee River to serve Newlands Project water rights
- To minimize the use of the Truckee River and maximize the use of the Carson River

These purposes are met through the implementation of several provisions and components. Provisions of particular importance to the Study include:

- **Maximum Allowable Diversion –** The Maximum Allowable Diversion (MAD) places an upper limit on the total amount of water that may be diverted for Project use in a given year. The MAD is calculated annually to represent anticipated Project demand; it is based on the acres of eligible land anticipated to actually be irrigated in that year.

- **Truckee River Diversions/Lahontan Storage Targets –** The amount of Truckee River water that can be diverted at Derby Dam for Project use is calculated monthly based on demand in the Truckee Division and on the need to meet storage objectives in Lahontan Reservoir. If the storage targets are unlikely to be met, additional Truckee River water may be diverted and conveyed to Lahontan Reservoir. Lahontan Reservoir storage objectives are based on projected inflow from the Carson River, anticipated demand in the Carson Division, and delivery efficiency; OCAP dictates specific storage targets from January through June. Lahontan storage objectives are calculated monthly between July and December. Truckee River diversions are calculated monthly.

- **Conveyance System Efficiencies –** Conveyance system efficiency targets vary annually, are specified in OCAP, and consider both conveyance losses due to factors such as seepage and the amount of water actually delivered to Project users at the headgates. The efficiency requirements are higher as the percent of entitlement water actually delivered at the headgates increases.

Precautionary Drawdowns and Spills In some years, it is necessary for Lahontan Reservoir to release “excess” water for reasons other than irrigation. The need and criteria for making these releases is determined by TCID and Reclamation; in general, such releases are made when inflow to Lahontan Reservoir is greater than available storage capacity.

Outside the irrigation season, water from precautionary drawdowns is delivered to land, water righted or not, in the following priority: (1) Lahontan Valley wetlands, including Stillwater NWR, Fallon NWR, Carson Lake and Pasture, and the Fallon Paiute-Shoshone Indian Reservation wetlands; (2) regulating reservoirs; (3) lands. During the irrigation season, this water is made available in the following priority: (1) water-righted irrigated land; (2) regulating reservoirs; and (3) Lahontan Valley wetlands. Deliveries of this water for irrigation are charged against the user’s water allocations, but deliveries for wetlands are not.

When (a) all preceding options have been used to the maximum extent possible, (b) the flows at the USGS gage on the Carson River at Tarzyn Road are forecasted to exceed 500 cfs, and (c) Reclamation determines there is a threat to public safety, then all water released to the Project is to be available to any lands, water-righted or not, at no charge against Project allocations for that year.

Newlands Project Water Demands The annual volume of Project water demand is set by the "duty" of individual Project rights, the acreage of rights among each duty, and cultural practices for taking different proportions of the total water right duty.

"Duty" is the maximum amount of water, per acre, that any property has the legal right to receive on an annual basis. Water duties in the Newlands Project vary, depending upon a combination of several factors, including soil, depth to groundwater, beneficial use, conveyance efficiency, on-farm efficiency, soil slope and character, weather, and consumptive use. Table 3-13 displays all of the water duties in the Project and the related documents in which they were established.

Table 3-13. Established Water Duties in the Newlands Project

Type of Use	Duty	Reference
Irrigated Bench Land	4.5 acre-feet per acre	*Alpine* Decree[1]
Irrigated Bottom Land	3.5 acre-feet per acre	*Alpine* Decree[1]
Irrigated Pasture	1.5 acre-feet per acre	*Freeman* and *Kent* agreements[2]
Wetlands	2.99 acre-feet per acre	*Alpine* Decree[1]; May 2011 Federal Court Order[3]

Sources
[1] United States v. Alpine Land and Reservoir Company, 503 F.Supp. 877 *(D.Nev., 1980)*
[2] Freeman Vested Water Right Agreement, *July 21, 1919;* Kent Vested Water Right Agreement, *March 15, 1926.*
[3] *Pyramid Lake Paiute Tribe of Indians v. Nevada State Engineer, "*In Re: Nevada State Engineer Ruling No. 5759," (D.Nev., 2011)

Records indicate that the Project, at its peak, contained 73,675 acres of water righted lands. About 10,000 acres of these original rights have been permanently retired, forfeited or are identified for future retirement under the Water Rights Compensation Program, leaving approximately 63,596 acres of unretired water rights whose owners have been paying assessments to TCID. Since the 1980s, between 41,000 and 59,000 acres have been irrigated, leaving a net difference of about 4,000 acres of water rights whose owners have been paying assessments but are not receiving water. These rights have not been specifically identified by any agency or through this Study, and a thorough review of every Project water right would be needed in order to identify which may be inactive.

The Nevada State Engineer determines the validity of water rights under Nevada law and there is some uncertainty as to whether any of the 4,000 inactive water-righted acres will ever be used or transferred. The State Engineer has indicated that a right-by-right assessment would be needed to make a certain determination of each right's validity, which would require identification and evaluation of each of the rights in question. Without a right-by-right assessment for identifying which of these rights will ultimately be forfeited and without funded programs for retiring any of these rights, this Study treats the inactive rights as potentially active. Consequently, any alternatives for the Study will need to consider the costs to serve or retire these potentially active 4,000 acres of rights.

Table 3-14 reports the acreage and volume of Project water rights demand for all potentially active water rights. Both acreages and volumes reported are drawn from the more extensive analysis documented in Appendix C ("Projected Future Water Rights and Demands for the Newlands Project").

Table 3-14. Estimated Current and Potentially Active Newlands Project Water Rights, with Associated Maximum Potential Demand[1]

Carson Division Rights		Bench (acres)	Bottom (acres)	Wetland (acres)	Pasture (acres)	TOTAL Acres	Maximum Demand (acre-feet)
Ag	Commercial and Noncommercial Farms	10,105	30,893	22	2,382	43,403	157,239
	Fallon Paiute-Shoshone Irrigated Lands	-	3,025	-	-	3,025	10,588
M&I	City of Fallon & Churchill County	118	648	-	-	766	2,799
Env	USFWS Water Rights	-[2]	-[2]	8,298[2]	641	8,939	25,773
	Carson Lake and Pasture	-[2]	-[2]	2,403[2]	-	2,403	7,183
	Fallon Paiute-Shoshone Tribal Wetlands	-	-	468	-	468	1,400
	Carson Division Subtotal	10,223	34,566	11,191	3,023	59,003	204,981
Truckee Division Rights		**Bench (acres)**	**Bottom (acres)**	**Wetland (acres)**	**Pasture (acres)**	**TOTAL Acres**	**Maximum Demand (acre-feet)**
Ag	Commercial and Noncommercial Farms	2,301	-	-	-	2,301	10,355
M&I	City of Fernley & Lyon County	2,103	189	-	-	2,292	10,124
	Truckee Division Subtotal	4,404	189	-	-	4,593	20,479
	TOTAL Potentially Active Newlands Project Rights	**14,627**	**34,755**	**11,191**	**3,023**	**63,596**	**225,461**

Notes:

[1] Figures have been rounded to their whole-number equivalents; as a result, some rounding errors may exist.

[2] TCID records indicate acreages of water rights attributed to USFWS and Carson Lake and Pasture with bench and bottom land duties. This Study assumes that these acreages will be transferred to a Wetland duty designation, and values of USFWS rights have been adjusted to reflect this assumption. Unadjusted acreages for USFWS were 15, 888, and 7,395 for bench, bottom and wetland, respectively. Unadjusted acreages for Carson Lake and Pasture were 60, 28, and 2,314 for bench, bottom and wetland, respectively.

Key:
Ag = Agricultural
Env = Environmental
M&I = Municipal and Industrial
USFWS = U.S. Fish and Wildlife Service

Given the current extent and distribution of water rights in the Project, the total estimated potential water demand in the Carson Division is approximately 204,981 acre-feet (59,003 acres) annually, and the total estimated water demand in the Truckee Division is approximately 20,479 acre-feet (4,593 acres) annually.[1]

The demands reported in Table 3-14 reflect the maximum amount that could be demanded if all potentially active Project rights are exercised. The historical cultural practice for agricultural irrigators has been to use less than the maximum water right that could be called upon. Agricultural users in the Truckee Division have historically used an average of about 95 percent of their total water rights, and agricultural users in the Carson Division have used approximately 92 percent of their total water right (43 CFR 418, 1997).

Newlands Project Water Supply Reliability The ability of the Newlands Project to deliver water to water rights holders in a reliable manner is a primary objective for the Study. The ability of the Project to rely upon water supplies from two sources – the Carson and Truckee rivers – has lent the Project high levels of historic delivery. Nevertheless, Project water users have experienced severe shortfalls. In seeking a performance standard that could be used to assess the ability of Study alternatives to meet the water supply objective, consideration was given to historical deliveries. However, several factors make it difficult or inappropriate to rely upon the historical Project performance. For instance, operating criteria have changed significantly over the past 50 years; both the current and future capacity of the canal are significantly lower than intended during Project construction, and ongoing programs to transfer water rights are shifting the demand for water to different uses.

To lend perspective to what the Newlands Project might have experienced during the twentieth century, this Study conducted an analysis of water supply under the current OCAP, with the historically assumed Truckee Canal capacity (900 cfs), and the current blend of water rights within the Project (Table 3-13). Under the simulated Desired Reliability scenario, the average demand met across the 100-year analysis is 95 percent. The lowest demand met is 40 percent, which would occur under conditions like those experienced in 1992 during the drought of record. In the wettest 80 out of 100 years, at least 98 percent of demand is met.

Appendix D1, “Effects of Truckee Canal Capacity on Newlands Project Water Supply,” describes the results of this assessment in greater detail as the Desired Reliability scenario. Chapter 2, “Plan Formulation Process,” contains additional explanation for how the Desired Reliability scenario is used in the Study, and Chapter 4, “Measures and Preliminary Alternatives,” describes how the Study

[1] The Project demand assumptions for this Study differ from those included in the TROA EIS/EIR. This Study’s assumptions for current and future demand are based on all potentially active water rights, regardless of whether they had been irrigated over the previous decades. See Appendix C for an explanation of the Study’s assumptions and analysis to estimate Project demand.

applied the Desired Reliability scenario to guide the preliminary alternative formulation process.

Groundwater Resources

Groundwater in the primary and extended study areas generally moves from recharge areas in the mountains and alluvial slopes to the valley floor (Tracy and Unger 2008). The principal groundwater aquifers are basin-fill aquifers, though a volcanic-rock aquifer near Fallon has been developed for municipal use. Basin-fill aquifers are composed primarily of alluvium, colluvium, and lacustrine deposits, and most groundwater use has been from the upper 500 feet of the aquifers (Reclamation 2011j). Groundwater from one basin may flow into another, and often there is insufficient information to fully characterize this flow between basins.

There are four general aquifer systems underlying the primary study area (Reclamation 1994). They are:

1. Shallow alluvial aquifer system extending from ground surface to about 50 feet in depth

2. Intermediate aquifer system underlying the shallow system and extending in some areas to depths of 500 to 1,000 feet

3. Basalt-aquifer system which is mushroom-shaped, almost completely enclosed by unconsolidated sediments, and related geologically to the volcanic cone located northeast of Fallon

4. Deep alluvial aquifer system generally below depths of 500 to 1,000 feet

The depth to water beneath most of the Project is less than about 25 feet below ground surface and, near irrigated areas, less than 10 feet below ground surface (Reclamation 1994). Confined conditions exist throughout much of the Carson Desert. Many deep wells have higher static ground-water levels than shallow wells, and the static water levels in these deep wells are above the top of the permeable formation which they tap, creating artesian wells, some of which flow frequently.

Surface water irrigation from the Newlands Project has altered the regimen of ground water since the early 1900s (Reclamation 1994). In 1904, the depth to water increased with increasing distance from the natural channels of the Carson River. Water levels were less than 10 feet within 2 miles of the channels and increased to about 25 feet or more in areas between the channels. In 1992, the water table had risen more than 15 feet over a large area, and near Soda Lake, ground-water levels increased more than 30 feet.

Groundwater recharge in the Fernley area is affected by (1) infiltration of precipitation, (2) infiltration from streams and canals, (3) underflow from the nearby highlands, and (4) infiltration of irrigation water (Sinclair and Loeltz 1963, Reclamation 2000). Seepage from the Truckee Canal between Derby Dam and Lahontan Reservoir has been estimated as high as 31,000 to 35,000 acre-feet per year (Sinclair and Loeltz 1963, Reclamation 1994). In recent years of operation, between 2001 and 2010, total losses to seepage and evaporation from the Truckee Canal and its laterals have remained between 10,000 and 25,000 acre-feet per year (Appendix A).

Groundwater in the Carson River Basin above Lahontan Reservoir flows from recharge areas in the mountains and alluvial slopes to the valley floor, west to east (Tracy and Unger 2008). Specific yields are higher in the fluvial and alluvial sedimentary soils close to the river channel and the reservoir (Maurer 2011). Below Lahontan Reservoir, groundwater recharge resulting from precipitation within the Lahontan Valley is estimated at about 1,300 acre-feet per year (WRD 2003), occurring only on the eastern side of the valley. Most private wells in the basin are used for domestic purposes; irrigation needs usually are supplied by surface water. The estimated recharge from irrigation water varies from 50,000 to 100,000 acre-feet per year (Reclamation 2011j). Estimated groundwater recharge for the Fallon area is 56 percent from canal seepage, 37 percent from irrigation losses, 5 percent from precipitation, and 2 percent from Newlands Project drains (Herrera et al. 2000). Similarly, between Fallon and Stillwater Wildlife Management Area, estimated recharge is 47 percent from canal seepage, 40 percent from irrigation losses, 5 percent from precipitation, and 8 percent from Newlands Project drains (Reclamation et al. 2008).

Shallow groundwater within the Carson Division is administrated by the Nevada State Engineer. Churchill County and the U.S. Navy hold most of the rights for the shallow unconfined aquifer in this region, and use it for municipal and industrial applications. However, it is suspected that many of the residential water users within the area may also have wells.

In the extended study area, groundwater recharge in California’s Martis Valley is estimated to be about 34,600 acre-feet per year (Nimbus Engineers 2001). Monitoring wells adjacent to the Truckee River indicate that groundwater is moving into the river (Nimbus Engineers 2001). Most groundwater pumping in the Truckee River Basin occurs in Truckee Meadows, which is used to supplement the municipal surface water supply for the cities of Reno and Sparks. Estimated groundwater recharge in Truckee Meadows is 29,000 acre-feet per year and comes from infiltration of precipitation (mainly snowmelt); irrigation return flows; and seepage from ditches, canals, and streambeds (Reclamation et al. 2008).

In the Dixie Valley, approximately 35 miles east of Fallon, the perennial groundwater yield has been estimated to be as low as 18,000 acre-feet per year (Mahannah 2005) or as high as 50,000 acre-feet per year (WRD 2003). Currently, the U.S. Navy holds about 14,000 acre-feet of permitted and certificated groundwater rights, of which at least 6,000 may be in forfeiture (Mahannah 2005), and Churchill County has pending applications for over 56,000 acre-feet (Reclamation 2011j). A number of export studies have been conducted to assess transport of Dixie Valley groundwater to Stillwater NWR or to Lahontan Reservoir for use in the Lahontan Valley (Mahannah 2005, Churchill County 2003a and 2007).

Water Quality

From Lake Tahoe to Reno, the Truckee River basin is relatively pristine. The primary water quality concern for the reach from Lake Tahoe to Reno is the potential for warm water temperatures downstream from the discharges of Tahoe-Truckee Sanitation Agency (TTSA) and Truckee Meadows Water Reclamation Facility (TMWRF), particularly during periods of low flow (Reclamation et al. 2008). The 1996 WQSA establishes actions, such as water storage and releases during low-flow conditions, to meet water quality objectives for nutrients and dissolved oxygen. The Truckee River total maximum daily load (TMDL) addresses total nitrogen, total phosphorus, and total dissolved solids upstream from Lockwood, Nevada. Water diverted at Derby Dam, from the diversion to Truckee Canal, has an average turbidity of 7.0 nephelometric turbidity units (NTU), total dissolved solids (TDS) of less than 200 parts per million, and arsenic concentrations of 14 parts per billion (WRD 2003).

The Carson River, from New Empire in Carson City to the Carson Sink, is listed on the National Priorities List because of mercury contamination from historic mining (Reclamation 2011j). The State of Nevada recommends no consumption of any fish from any waters in the Lahontan Valley due to elevated mercury levels (NDOW 2010, Reclamation 2011j). The Carson River, from Lahontan Reservoir to the Carson Sink, also is listed as warranting further investigation for possible impairment by total iron. The Carson River TMDL addresses dissolved oxygen, biochemical oxygen demand, orthophosphates, nitrates, and TDS upstream from Lahontan Reservoir. However, Lahontan Reservoir water has relatively low turbidity, 5.5 to 14.0 NTU, and low salinity, with TDS less than 300 milligrams per liter (WRD 2003). Water quality limitations include seasonal algae accumulations, arsenic, trihalomethanes, and pathogens.

In and below the Newlands Project, Stillwater NWR receives irrigation return flows and drain water. Nevada requires that irrigation return flows meet State agricultural water quality standards; drain water standards are less stringent. USFWS owns water rights for Stillwater NWR and will take irrigation return flows to meet those rights as long as the water quality is within Nevada standards. USFWS cannot refuse to use Stillwater NWR for disposal of drain water unless they determine that the water is toxic to migratory birds (USFWS 1996a).

Below the surface, soil salinity in the primary study area sediments impairs groundwater quality. Typically, groundwater quality decreases with depth, and potable supplies must be taken from basin margins or higher elevation valleys (Reclamation 2011j). Sediments in the Fernley area contain highly soluble mineral salts. Previous studies noted that the concentration of dissolved solids of water in the Truckee Canal was recorded at 128 parts per million (ppm) while water sampled from a pond located downgradient from the canal had a dissolved solids concentration of more than 3,200 ppm (Tracy and Unger 2008). Related analyses of 31 groundwater wells in the Fernley area showed dissolved solids concentrations ranging from 163 ppm to 4,190 ppm (Reclamation 2000). Lahontan Valley and Dixie Valley groundwater meet Nevada drinking water standards, except for arsenic in Lahontan Valley, and arsenic and fluoride in Dixie Valley (Reclamation 2011j).

Likely Future Without-Action Conditions

As noted in the “Biological Environment” and “Socioeconomic Environment” sections above, anticipated shifts in ownership of Project water-righted acres from agricultural application to wetland management practices, environmental purposes, and municipal dedications, will result in overall reduction of Project water demand in the primary study area (Appendix C). For the purpose of this Study, alternatives described in Chapter 5 were constructed and evaluated with the assumption that agricultural water right demands would continue the historical cultural practice of using a reduced (95 percent) portion of their maximum water rights volume. All other water rights holders were assumed to use their full maximum demand. This assumption intends to capture the likely demand for the anticipated acreage of agricultural water rights as shown in Table 3-15, and should not be construed as a diminishment of the water rights.

Table 3-15. Projected Future Potentially Active Newlands Project Water Rights, with Associated Demand[1]

Carson Division Rights		Bench (acres)	Bottom (acres)	Wetland (acres)	Pasture (acres)	TOTAL Acres	Demand (acre-feet)
Ag	Commercial and Noncommercial Farms	9,830	19,104	22	2,382	31,338	105,560[3]
	Fallon Paiute-Shoshone Irrigated Lands	-	3,025	-	-	3,025	10,588
M&I	City of Fallon & Churchill County	118	648	-	-	766	2,799
Env	USFWS Water Rights	-[2]	-[2]	20,362[2]	641	21,003	61,844
	Carson Lake and Pasture	-[2]	-[2]	2,403[2]	-	2,403	7,183
	Fallon Paiute-Shoshone Tribal Wetlands	-	-	468	-	468	1,400
	Carson Division Subtotal	9,948	22,778	23,255	3,023	59,003	189,734
Truckee Division Rights		**Bench (acres)**	**Bottom (acres)**	**Wetland (acres)**	**Pasture (acres)**	**TOTAL Acres**	**Demand (acre-feet)**
Ag	Commercial and Noncommercial Farms	1,451	-	-	-	1,451	6,204[3]
M&I	City of Fernley & Lyon County	2,353	189	-	-	2,542	11,249
	Truckee Division Subtotal	3,804	189	-	-	3,993	17,435
	TOTAL Potentially Active Newlands Project Rights	**13,752**	**22,966**	**23,255**	**3,023**	**62,996**	**206,827**

Notes:
[1] Figures have been rounded to their whole-number equivalents; as a result, some rounding errors may exist.
[2] TCID records indicate acreages of water rights attributed to USFWS and Carson Lake and Pasture with bench and bottom land duties. This Study assumes that these acreages will be transferred to a Wetland duty designation, and values of USFWS rights have been adjusted to reflect this assumption. Unadjusted projected acreages for USFWS are 290, 12,667, and 7,395 for bench, bottom, and wetland, respectively. Unadjusted acreages for Carson Lake and Pasture are 60, 28, and 2,314 for bench, bottom, and wetland, respectively.
[3] Demand for agricultural water rights holders reflect historical cultural practice of receiving less than the full water right: 95% of total water right demand for Truckee Division and 92% for Carson Division.

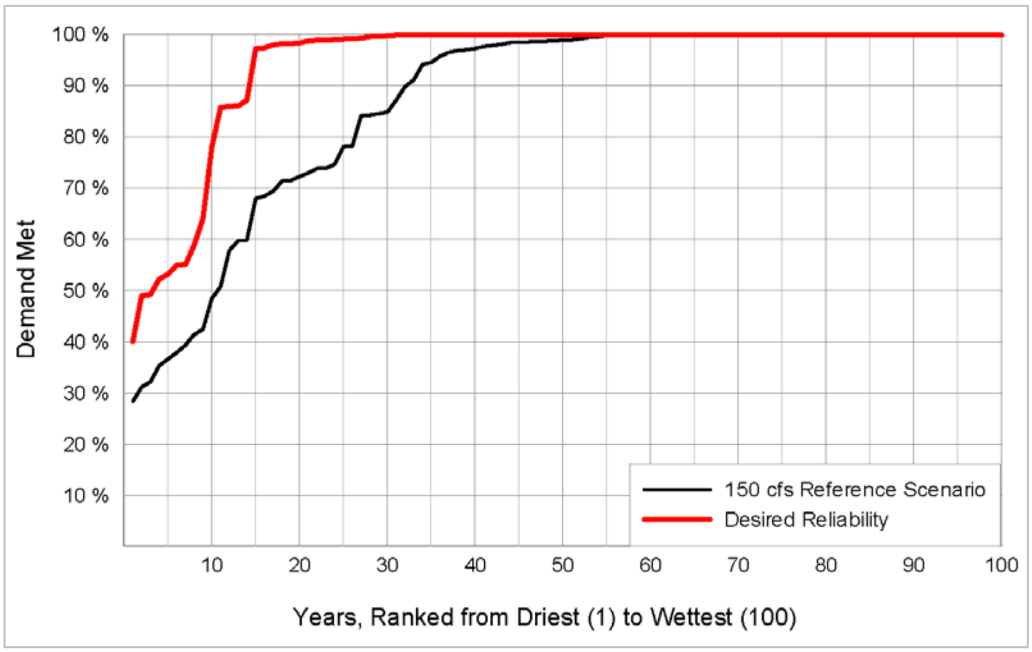
Key:
Ag = Agricultural
Env = Environmental
M&I = municipal and industrial
USFWS = U.S. Fish and Wildlife Service

The 150 cfs flow-stage Truckee Canal capacity restriction, described in the “Infrastructure” section above, will have a large effect on the Project’s overall reliability and ability to meet demand from agricultural and other users.

Pressure from regional stakeholders will continue to increase efficiencies of Project water use for agriculture, including reuse of agricultural drain water. Increases in efficiencies would likely result in reductions to both groundwater recharge and drain flows to the Stillwater NWR. Reductions in groundwater recharge could result in reductions in water surface tables that allow for some rights holders to petition for their lands currently classified as bottom lands to be reclassified as bench lands. Reclassification could result in increased total demand for water for the Carson Division; however, the efficiency gains that would lead to this increase would also provide overall greater water supply reliability for the division (Appendix D4).

Key Study Assumptions

Water demand for agricultural uses within the Project will decrease, and Project efficiency will likely increase, but neither will offset the reductions in overall water supply reliability experienced by Project water rights holders as a result of the restricted flow stage (150 cfs) in the Truckee Canal (see Figure 3-16). Shortfalls will be more frequent and more severe overall. Long-term average Project water deliveries will be reduced 8 percent from 95 percent (under the Desired Reliability scenario) to 87 percent. During the driest 20 percent of years, Project rights holders would receive an average of 51 percent of their water rights each year, a 23 percent greater shortfall than experienced under the Desired Reliability. Appendices B2 and D1 contain the detailed analyses used to develop these assumptions.



Key: cfs = cubic feet per second

Figure 3-16. Potential for Shortages Under the Likely Future Without-Action Condition

As noted above, agricultural water right demands will continue the historical cultural practice of using a reduced (95 percent) portion of their maximum water rights volume, as reflected in Table 3-15. All other water rights holders were assumed to use their full maximum demand.

Chapter 4
Measures and Preliminary Alternatives

As described in Chapter 2, alternative plan formulation is an iterative process. Once water resources problems, needs, and opportunities have been identified, and planning objectives, constraints, considerations, and criteria have been developed, the next major elements of the planning process are (1) identifying management measures that may address one or more objectives, (2) formulating alternatives to meet these objectives, and (3) comparing and evaluating the alternatives.

This chapter of the Special Report describes the process to evaluate a range of measures and develop a set of preliminary alternatives, based on a range of Truckee Canal flow stages paired with selected measures that, in combination, address the identified problems and needs of the Newlands Project and achieve the Study objectives.

Structure of Planning Study Alternatives

All alternatives formulated for this Study must meet both the safety and water supply objectives described in Chapter 2. The 2008 and 2011 Truckee Canal Risk Assessments and the Corrective Action Study (Reclamation 2008c, 2011d, e) identify a host of repairs and other actions that, when undertaken, will allow the Truckee Canal to operate safely. This Study relies upon those recommendations for measures to satisfy the safety objective, and incorporates these as initial building blocks for building preliminary alternatives that, overall, will also achieve the Study's water supply objective.

Measures: A management measure is any structural or nonstructural action or feature that could address one or more planning objectives, consistent with other planning considerations, criteria, and constraints. At each step of the planning process, measures are reviewed, and in some cases reconsidered and incorporated into alternatives or eliminated from further consideration.

Alternatives: An alternative (sometimes called "alternative plan") is a course of action to resolve an identified problem. Most alternatives include a combination of measures for implementation, but some alternatives are considered "no action" because they represent the most likely future condition absent any action to address the problem.

Approaches for meeting the safety objective are distinguished by a range of actions and allowable flow stages for the Truckee Canal; this range of flow stages directly affects the ability of the Newlands Project to provide water supply reliability to Project water rights holders. As such, development of each alternative requires determination of whether additional measures are necessary to also achieve the water supply objective. This section first describes the measures for meeting the safety objective and, second, the measures for meeting the water supply objective.

Measures Identified for Achieving Safe Operations of the Truckee Canal

Actions identified to reduce the risk of the Truckee Canal's embankment failing include physical repairs, upgrades, and reduced flow stages. This section describes how measures have been identified and may be combined with reduced canal flow stages to meet the Study's safety objective.

Truckee Canal Flow Stages

Each alternative will be constructed by first selecting a target flow stage for the Truckee Canal. The following bullets describe the range of flow stages considered:

- **600, 350, and 250 cfs Flow Stages –** At flow stages between 600 cfs and 250 cfs, each measure for achieving safety includes a number of general upgrades to checks, wasteways, conduits, and takeouts, with three different options for structural improvements along the length of the canal surface or embankment. Through these measures, the corrective actions address defects that have developed within the canal embankment, and the increased risk resulting from a transition in land use around the canal from agricultural cultivation to residential communities. Each measure provides for meeting the RR3 standard of safety, which is required for achieving this Study's safety objective.

- **0 cfs Flow Stage –** The Corrective Action Study evaluated reducing the risk of canal failure by decommissioning the canal from use. Decommissioning the canal would address all of the public safety risks its use currently poses, as well as risks that an abandoned canal might pose without further action (e.g., attractive nuisances and stormwater drainage).

- **150 cfs Flow Stage –** This Study includes a 150 cfs flow stage as a method for achieving the safety objective. Although this flow stage was not evaluated in the Corrective Action Study, Reclamation previously determined that the Truckee Canal could safely operate at this level without additional repairs or upgrades (Reclamation 2008c, d). The 150 cfs flow stage reflects the operational and capacity restrictions on the Truckee Canal under the "Likely Future Conditions" described in Chapter 3.

Structural Integrity Improvements Along the Truckee Canal

The Corrective Action Study identified three techniques for improving the structural integrity along approximately 17 miles of the Truckee Canal's embankments: 1.7 miles of the 10.3-mile Derby Reach and 4.2 miles of the 9.7-mile Lahontan Reach, which have relatively low population densities near the canal; and the full 11.1 miles of the Fernley Reach, which has the greatest population density along the canal and thus the greatest risk. These three techniques can be applied equally in combination with the other measures to satisfy the safety objective at flow stages of 250, 350, and 600 cfs. The three techniques identified for improving structural integrity along the length of the canal are:

1. **Concrete and geomembrane lining –** For this lining option, a low-density polyethylene geomembrane 40 thousandth of an inch thick would be placed on the canal's prism (along the sides and bottom of the structure) and covered by a layer of unreinforced concrete 3 inches thick. The canal section would be designed to a smaller cross-section prism than the existing channel geometry. The concrete lining protects the geomembrane from being damaged during maintenance work or large debris flows, and by animals. Seepage into the canal embankment would essentially be eliminated in the sections of the canal where the geomembrane and concrete liner are installed. This would also reduce losses from the canal due to seepage by up to 85 percent. Once the lining system is in place, all static failure modes evaluated for the canal would be eliminated. Depending on the flow stage selected, the estimated field cost for a full canal concrete and geomembrane lining ranges from $53 million to $59 million.

2. **Cement bentonite cutoff wall –** For this non-lining option, a trench would be excavated in the centerline of the canal embankment and filled with a slurry mix of cement, bentonite, and water. Exposed defects, such as animal burrows or cracks, within the trench would also be filled with the slurry. The cement bentonite slurry would harden over time to form an impermeable barrier within the canal embankment. The excavated soil and slurry from the trench would be used to reshape the canal embankment, as needed. The installation of a cement bentonite cutoff wall would eliminate all of the existing seepage paths and provide a deterrent to future rodent activity through the canal embankment. Depending on the flow stage selected, the estimated field cost for a cement bentonite cutoff wall ranges from $50 million to $56 million.

3. **High-density polyethylene cutoff wall –** For this non-lining option, interlocking panels of high-density polyethylene (HDPE) would be pushed and vibrated into the centerline of the canal embankment. The installation of an HDPE wall would eliminate all of the existing seepage paths and eliminate the potential for future rodent activity

through the canal embankment. A cap would be installed at the crest to prevent damage to the top of the HDPE geomembrane wall. Depending on the flow stage selected, the cost for an HDPE cutoff wall ranges from $40 million to $44 million.

The three techniques will help meet the safety objective, addressing risk at RR3, equally well; however, they differ in regard to cost and in their performance characteristics. For instance, the concrete and geomembrane lining technique would significantly reduce losses from the Truckee Canal by acting as a barrier against seepage, but is also the most expensive option. In contrast, neither of the cutoff wall techniques would reduce seepage losses from the canal into the surrounding groundwater aquifers, although these options have lower costs. It is possible that these costs could be reduced if value engineering were performed for these safety measures.

The lower cost techniques appear to be attractive options, given that all three provide the same level of risk reduction for meeting the safety objective. However, if additional seepage-reduction benefits are necessary to meet the water supply objective, the higher cost technique, concrete and geomembrane lining, may be considered. Among the lower cost techniques, the cement bentonite cutoff wall is more expensive than the HDPE cutoff wall, but provides no additional water supply or safety benefits to justify its higher costs. For the purposes of formulating preliminary alternatives, the lower cost option for HDPE cutoff walls is assumed to be the starting point. The decision to bear the additional costs associated with selecting concrete and geomembrane lining is made in concert with decisions to select other measures for meeting the water supply objective.

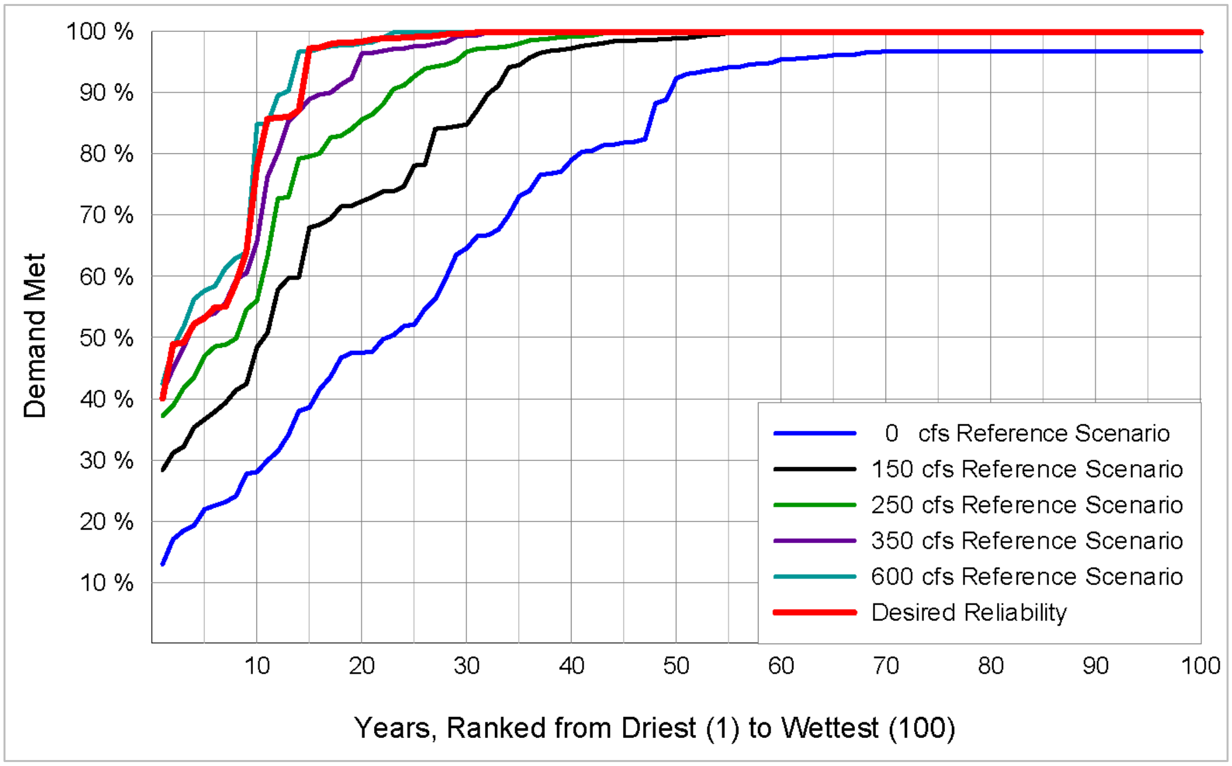
In parallel with this Study, Reclamation is refining the hydrologic analysis used in developing the above safety measures. The updated analysis may reduce the assessed risks of natural runoff, and thereby reduce the extents and cost of structural requirements for safety options. The revised hydrology study was completed in 2012. Development of additional analyses will be required to update cost estimates for the safety measures, but is unlikely to occur before the completion of this Study.

Reference Scenarios: For this Study, Newlands Project water supply reliability has been simulated at a range of Truckee Canal flow stages and for Desired Reliability conditions, taking into account anticipated future levels of Project demand. These are termed “reference scenarios.” Each flow-stage reference scenario is used as the basis for comparing how well each meets Project demand, and for determining what must be done to achieve reliability levels similar to the Desired Reliability scenario.

Measures Needed to Meet Water Supply Objective

The safety measures for the Truckee Canal described above will ensure all alternatives developed meet the Study’s safety objective, but – like the 150 cfs flow-stage restriction described in Chapter 3 – they may also result in a less reliable supply of water for Project users when compared to Desired Reliability conditions.

The Study involved several analyses to determine the extent of shortages in meeting future water rights under each flow stage considered in alternatives formulation (Appendix D1).



Key: cfs = cubic feet per second

Figure 4-1. Newlands Project Water Supply Reliability Under all Reference Scenarios

Based on the Study's analyses, a number of general conclusions are possible about the reliability under each flow-stage reference scenario (Figure 4-1), absent any additional safety methods or water supply measures:

- In general, water supply reliability conditions under the 600 cfs reference scenario are slightly better than Desired Reliability conditions.
- Reliability under the 350 cfs reference scenario is nearly identical to the Desired Reliability scenario in the driest and wettest of years, but offers slightly lower levels of reliability during what were more moderate shortage conditions under the Desired Reliability scenario.
- Reliability under the 250 cfs reference scenario is lower than the Desired Reliability in all years.

- Reliability under the 150 cfs reference scenario contains approximately double the volume of shortfalls as the 250 cfs reference scenario, in comparison to the Desired Reliability. Shortages are exacerbated most in the driest years and in prolonged droughts.

- For conditions under the 0 cfs reference scenario, reliability is significantly lower than under the Desired Reliability scenario, with water supply shortages for the Carson Division occurring in approximately half of all years. The 0 cfs flow-stage reference scenario never achieves Desired Reliability for the Truckee Division, because if the Truckee Canal is decommissioned, Project water rights holders in the Truckee Division will need to be served through an alternate mechanism.

Water Supply Measures Identified and Evaluated

One of the Study's requirements is to formulate and evaluate alternatives for a range of potential Truckee Canal flow stages. Thus, combination of these flow stages along with the previously identified safety measures established the initial range of preliminary alternatives. Starting with the selection of a given flow stage, the potential water supply shortage that remains – when compared to the Desired Reliability – establishes the needs to be met or targets to be reached through the addition of one or more water supply measures (Figure 4-2).

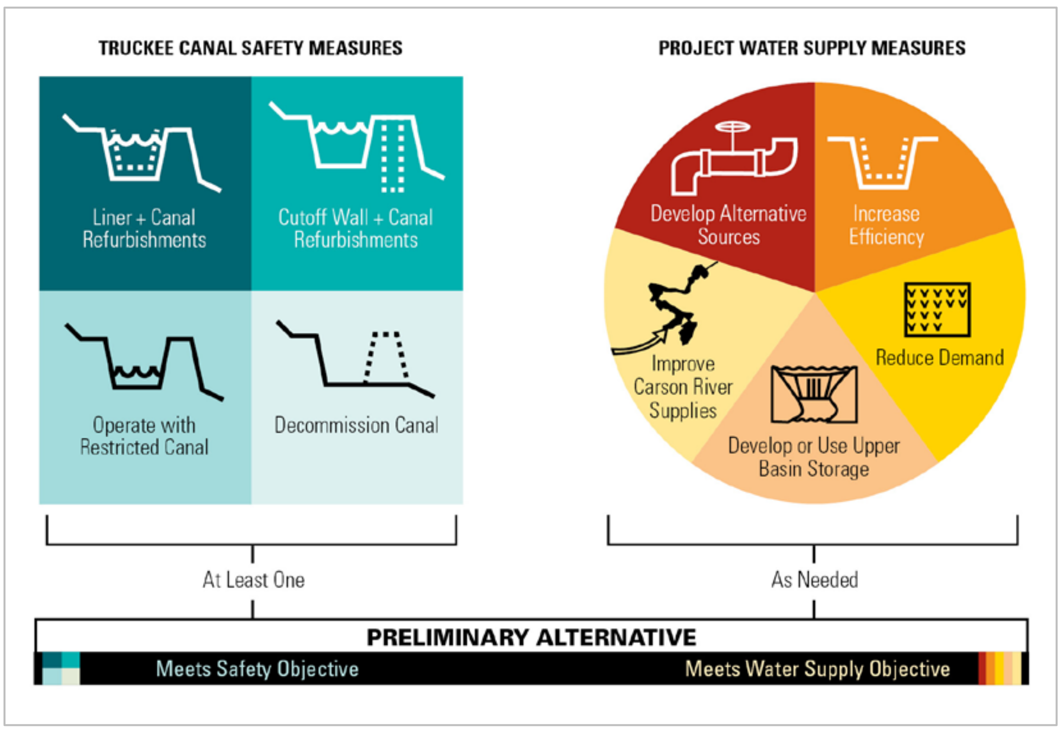


Figure 4-2. Structure of Alternatives to Meet Study Objectives

More than 50 potential water supply measures were initially identified for the Study based on information from previous studies, programs, and projects. These measures were reviewed and others developed during Study team meetings, field inspections, and meetings to discuss the Study with Project stakeholders, agencies, and the public. Measures were grouped into 5 broad categories based on their intent or purpose, and further organized into 18 subcategories to allow for easy comparison and evaluation.

A list of all the measures identified and their selected characteristics appears in this chapter, and a full description of each measure and its evaluation is included in Appendix E1.

Develop Alternative Sources Measures in this category provide alternative sources of supply or means of delivery to ensure water rights holders throughout the Project receive water reliably in the future. In some cases, the alternative sources are new supplies not already derived from the Carson or Truckee rivers. In other cases, the alternative source is existing Project water to be delivered in a different manner or from an alternate conveyance mechanism—specifically, many of these measures are intended to ensure a system is in place that allows the Truckee Division to exercise its water rights, regardless of the state or condition of the Truckee Canal.

Develop or Use Upper Basin Storage Measures in this category were identified to develop additional storage in the upper Carson River Basin for use by the Newlands Project, or to use existing upstream storage on the Truckee River. These measures would contribute to the water supply objective of this Study by (1) capturing additional water during excess conditions for later delivery, or (2) providing more flexibility to deliver Project water when it is most useful.

Improve Carson River Supplies Measures in this category seek to improve the reliability of supplies in Lahontan Reservoir through the reductions in reservoir spill or increases in dependable inflow from the Carson River. This includes expanded monitoring of upstream diversions and changing enforcement of the *Alpine* Decree to improve flows to Lahontan Reservoir. These measures contribute to the objectives of this Study by increasing the volume of water available for delivery to Carson Division water rights holders, and reducing dependence upon supplies from the Truckee Canal.

Increase Efficiency Measures in this category focus on achieving more efficient or effective use of Project water supplies, especially within the Carson Division. These measures contribute to the water rights reliability objective of this Study by using water at Lahontan Reservoir more effectively, or by reducing the overall losses within the Project. As a result, they produce either lower shortfalls in dry conditions, or greater carryover storages in normal or wet conditions.

Reduce Agricultural Demand Measures in this category focus on reducing Newlands Project water demands, either during drought conditions or permanently. Methods vary widely within this category, ranging from financial assistance programs to the retirement of water rights. These measures seek to contribute to the water supply objective by better balancing the demands for water with the available supplies in any given year.

Consideration of Measures for Water Supply Objective

This section describes the process and information used to consider and screen each measure identified to meet the water supply objective, or to compare measures within their categories and subcategories where appropriate to determine which represented the best options for use in alternatives.

Measures Screening Process

Once the measures were identified, the Study team initiated a screening process to help identify the measures that represent the best candidates for further evaluation and consideration. This process narrowed the list of measures by eliminating any that were unlikely to be included in alternatives, and then ranked and compared the remaining measures based on their relative attractiveness for potential inclusion in alternatives.

Phase 1: Initial Screening

Initially, screening relied on existing information and input received during meetings with the public, cities and counties, Federal agencies, regional agencies, and tribes; feedback from Reclamation staff in the Lahontan Basin Area Office; information obtained from reference material described in Chapter 1 and cited throughout this report; and Study team judgment. New analyses were conducted when additional information was required to complete the evaluations. To complete this initial step in screening, measures were evaluated based on three general categories: (1) implementation considerations, (2) environmental effects, and (3) water supply performance. Although this part of the screening process is qualitative and subjective in nature, it aims to identify the measures to be evaluated further in the planning process and remove measures from further consideration if their overall intent or likely outcome will not contribute to achieving Study objectives, or if they contain an aspect that represents a severe barrier or challenge to implementation.

- **Implementation considerations** are the factors and conditions that will affect whether a measure is likely or feasible to implement. Such considerations may include institutional hurdles or legality, political or public acceptability, regulatory requirements or hurdles, and the level of complexity or need for cooperation from multiple parties.

- **Environmental effects** are the environmental resource conditions that are expected to change as a consequence of a measure's implementation. In some cases, these effects are small and may be mitigable; in others, the expected effects are severe enough to reduce the attractiveness of the measure's potential water supply benefits.

- **Water supply performance** is a reflection of a measure's expected contributions to or effectiveness in meeting the Study's water supply objective. Specifically, it is described in terms of potential yield, magnitude of the yield in years with shortages, overall performance achieving its intent, and, if relevant or useful, cost effectiveness.

As a result of this initial evaluation, 18 of the 51 measures examined were judged to have a high likelihood to encounter serious conflicts or result in adverse conditions in these three assessments, and thus were eliminated from further evaluation and consideration for use in formulating alternatives (see Table 4-3, beginning on page 4-17 of this chapter).

Phase 2: Secondary Analyses

For the 33 measures that remained following Phase 1 screening, the Study team began a second, more robust assessment to estimate each measure's cost and contributions to meeting the water supply objective, alone or in combination. Several analyses contributed to this step in the screening process and are summarized in multiple appendices to this Special Report. Where possible, these analyses included sensitivity studies to evaluate entire subcategories of measures. The analyses produced a number of technical conclusions that guided development of preliminary alternatives, summarized below.

- **Water supply conditions vary considerably between a Desired Reliability scenario and the various other Truckee Canal flow-stage reference scenarios used for building alternatives**. The reference scenarios are the foundation for building alternatives, with the goal of including measures until the resulting conditions meet or exceed the water supply conditions of the Desired Reliability scenario. (See Appendix D1, "Effects of Truckee Canal Capacity on Newlands Project Water Supply.")

- **Reducing seepage from the Truckee Canal provides a considerable enhancement to the reliability of Newlands Project**. The reliability improvements appear to be greatest for the 600 cfs and 350 cfs flow-stage scenarios. (See Appendix D2, "Effects of Truckee Canal Losses on Newlands Project Water Supply.")

- **Reducing demand through permanent land retirement or crop insurance/fallowing programs is one possible mechanism for balancing demand under a future condition with a capacity-limited Truckee Canal**. If relied upon alone, rather modest reductions in demand are sufficient for achieving reliability under some of the flow stages (250 cfs and 350 cfs). For the 150 cfs flow-stage condition, reliability could be achieved with permanent retirement or temporary fallowing of 20 percent to 40 percent of the actively irrigated Project land. For the 0 cfs condition, the required acreage of retirement grows to 40 percent to 60 percent of the Carson Division, with separate requirements for the Truckee Division. (See Appendix D3, “Effects of Reducing Demand on Newlands Project Water Supply.”)

- **Increasing the delivery efficiency of the Carson Division’s canals and laterals shows an appreciable benefit to Project reliability**. Measures that bring Project efficiency to 75 percent may be able to meet the water supply objectives for several flow stages (250 cfs and 350 cfs) alone. Even with the possibility that increased efficiency would require reclassifying some land at a higher water duty, the benefit of efficiency gains exceed these potential diminishments. (See Appendix D4, “Effects of Increasing the Efficiency of Deliveries on Newlands Project Water Supply.”)

- **Increased inflows from the Carson River to Lahontan Reservoir do not result in improved water supply reliability for the Project**. Even if it were possible to securely deliver upper Carson River Basin water to Lahontan Reservoir, there can be no carryover from yearly storage of these additional flows due to the nature of OCAP. Storage in the upper Carson River Basin showed some opportunity, though the actual opportunity to benefit from acquiring storage rights was deemed marginal because the Project would need to acquire nearly all upstream Carson River storage to produce a perceptible water supply benefit. (See Appendix D5, “Effects of Acquiring Additional Carson River Storage and Water Rights on Newlands Project Water Supply.”)

- **Although it cannot be evaluated completely for this Study, there appear to be significant opportunities for the Newlands Project to benefit from upstream storage in the Truckee River Basin**. (See Appendix D6, “Potential Opportunities to Store Newlands Project Water in Truckee River Reservoirs.”)

- **New storage at Lahontan Reservoir is unlikely to benefit the Project.** The regulations in OCAP that limit diversions from the Truckee River relative to storage targets in Lahontan Reservoir also have the effect of limiting the value of developing additional storage in Lahontan Reservoir. For example, a larger Lahontan Reservoir does capture more water during wet conditions but, because of OCAP storage target limitations, higher carry-over storages result in lower Truckee River diversions instead of higher water supply availability for the Project. New storage was removed from consideration due to the findings in this appendix. (See Appendix D7, “Effects of Storage Increases on Newlands Project Water Supply.”)

Based on the secondary analyses, 18 measures were eliminated for further evaluation, as they generally showed no appreciable water supply reliability improvements (see Table 4-3, beginning on page 4-17 of this chapter). The remaining measures were retained for consideration in Phase 3 because of their ability to contribute meaningfully to meeting the water supply objective. The second phase of screening also uncovered compatibilities among the measures and Truckee Canal flow stages, which provided a basis for ranking the measures for inclusion in preliminary alternatives.

Phase 3: Selection of Measures for Preliminary Alternatives

During the third phase of screening, measures were identified for use in preliminary alternatives based upon their relative performance compared with similar measures, and their effectiveness and compatibility with other measures. Two measures not selected during this phase were removed from consideration in this Study (see Table 4-3, beginning on page 4-17 of this chapter).

Preliminary alternatives were built in several stages as follows, beginning with the flow stage reference scenario alone.

1. The amount of unmet Project demand that could occur under a given flow-stage condition was assessed by comparing the flow-stage reference scenarios developed for each flow stage with the Desired Reliability.

2. The initial flow-stage condition, paired with a safety measure, was then combined with measures that could offer the largest benefit in terms of relative water supply performance or cost effectiveness. The subcategory of measures that appeared to be the most effective and achievable was considered first. Measures within the subcategory were selected based on how much of the shortage (unmet Project demand) they are anticipated to erase at a given flow stage, relative to the Desired Reliability – in other words, how close they bring the Project to the Desired Reliability level.

3. If additional water supply gains were still necessary for the preliminary alternative to reach the level under the Desired Reliability, the Study team added more measures until no additional gains were possible from measures within that subcategory.

4. If additional water supply gains were still necessary to meet the water supply objective, the next-most-effective subcategory of measures was considered and additional measures were applied until the preliminary alternative met both the safety and water supply objectives.

Through this systematic approach, several preliminary alternatives were developed that used the full range of subcategories that had been advanced through phases 1 and 2 of the measures screening process. However, during the process of assembling preliminary alternatives, several measures that had been retained through previous rounds of screening did not emerge as the most efficient or effective measures for meeting the water supply goal for any of the preliminary alternatives. As a result, these measures were not retained for further evaluation in the preliminary alternatives.

Summary of Screening Results

This Study did not apply the same screening process described above to the safety measures, as Reclamation previously formulated and evaluated these options in the Corrective Action Study (Reclamation 2011e). As such, the following subsection focuses on the water supply measures that were retained through the screening process, and also identifies the measures that were eliminated from further consideration. For context, the range of measures identified for reducing risk from operations of the Truckee Canal that may be used in preliminary alternatives are shown below in Table 4-1.

Table 4-1. Safety Measures for Potential Use in Preliminary Alternatives

Measure		Estimated Field Cost[1] ($ millions)	Estimated Annual Cost[2] ($ millions)
600 cfs flow stage[3]	Concrete/ Geomembrane Lining	$59	$2.8
	CB Cutoff Wall	$56	$2.7
	HDPE Cutoff Wall	$44	$2.1
350 cfs flow stage[3]	Concrete/ Geomembrane Lining	$59	$2.8
	CB Cutoff Wall	$56	$2.7
	HDPE Cutoff Wall	$44	$2.1
250 cfs flow stage[3, 4]	Concrete/ Geomembrane Lining	$59	$2.8
	CB Cutoff Wall	$56	$2.7
	HDPE Cutoff Wall	$44	$2.1
0 cfs flow stage	Truckee Canal Decommissioning	$11	$0.52
150 cfs flow stage	TBD/Likely Future Without-Action Condition	$0.13	$0.016

Notes:

[1] Field cost is an estimate of capital costs of a feature or project from award to construction closeout, but does not represent total construction costs, which are the sum of field costs and non-contract costs. Allowances for mobilization, design contingencies, procurement strategies, and construction contingencies are included in field cost. Non-contract costs are not included in the field cost. Non-contract costs refer to costs of work or service provided in support of the Project, and other work that can be attributed to the Project as a whole, known as distributed costs, which include facilitating services, investigations, design and specifications, construction management, environmental compliance, and archeological considerations. Costs were indexed to January 2012 using Reclamation's Construction Cost Trends (Reclamation 2012).

[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life. Typically, interest and amortization is determined using total capital costs (construction cost plus interest during construction); however, total capital costs were not available. Operation and maintenance (O&M) costs are included in the annual costs and are typically expressed as a percentage of the field or construction cost for preliminary and/or appraisal level estimates. O&M costs were indexed to January 2012 using Reclamation's Construction Cost Trends (Reclamation 2012).

[3] Up to $1.7 million in field costs could be saved for 600 cfs, 350 cfs, and 250 cfs safety measures because of the recent TCID Truckee Canal turnout replacements.

[4] Costs for the 250 cfs flow stage were presented as a "transport-only" option in the *Corrective Action Study* (2011e), and differ from the 350 cfs flow stage because the turnout and check structure replacements are not included. For this Study, those structural features would be required and costs are assumed to be same as the 350 cfs flow stage.

Key:
CB = cement bentonite
cfs = cubic feet per second
HDPE = High Density Polyethylene
TBD = to be determined

Tables 4-2 and 4-3 summarize the results from the screening process for each measure considered. Table 4-2 includes all of the measures that were retained for use in preliminary alternatives, along with select characteristics such as potential yield, estimated field costs, and annualized costs. Table 4-3 presents comparable information, where available, for the measures that were not retained, and also provides a brief reason for eliminating each from further consideration by the Study.

Table 4-2. Water Supply Measures Retained for Potential Use in Preliminary Alternatives

Category	Subcategory	Measure	Source/Suggestion for Measure	Estimated Annual Yield	Estimated Field Cost[1] ($ million)	Estimated Annual Cost[2] ($ million)
Develop Alternative Sources	Supplement Truckee Division Supply	Treat Effluent and Deliver for Agricultural Use	Study Team	1,700 AF	$0 – $13	$0 – $1.85
	Supplement Carson Division Supply	Import Dixie Valley Groundwater	Churchill County 2007	35,000 AF	$63 – $135	$4.4 – $11
	Establish New Truckee Division Points of Diversion and Delivery	Construct Pipeline to Agricultural Users[4]	Study Team	1,100 – 3,300 AF	$110 – $120	$7.9 – $8.6
Increase Efficiency	Reduce Carson Division Seepage	Compact Soil Lining of Main Canals and Laterals	Study Team	26,100 – 36,200 AF	$1.7 – $4.5	$0.4 – $1.05
		Line Main Canals and Laterals	Reclamation 1994 and 2009b; 1997 OCAP	26,100 – 36,200 AF	$135– $195	$6.6 – $9.4
	Reduce Truckee Division Seepage	Compact Soil Lining of the Truckee Canal	Study Team	10,000 – 15,000 AF	$0.78 – $1.55	$0.19 – $0.37
		Line Truckee Canal	Reclamation 1994, 2009b, and 2011e	10,000 – 15,000 AF	$0 – $15.0	$0 – $0.73
Reduce Agricultural Demand	Modify Land Uses	Acquire and Retire Water Rights	Reclamation 1994 and 2009b	3.5 – 4.5 AF per acre	$1.285 per TAF[3]	$0.074 per TAF[3]

Table 4-2. Water Supply Measures Retained for Potential Use in Preliminary Alternatives (contd.)

Category	Subcategory	Measure	Source/Suggestion for Measure	Estimated Annual Yield	Estimated Field Cost[1] ($ million)	Estimated Annual Cost[2] ($ million)
Reduce Agricultural Demand	Reduce Dry-Year Demand	Crop Insurance/Fallowing	Pyramid Lake Paiute Tribe and Stetson Engineering	Varies	$0.065 - $0.1 per TAF per year[3]	$0.065 – $0.1 per TAF[3]
		Partial Season Forbearance Agreements	Pyramid Lake Paiute Tribe and Stetson Engineering	Varies	$0.065 - $0.1 per TAF per year[3]	$0.065 – $0.1 per TAF[3]
Develop or Use Upper Basin Storage	Access Truckee River Storage	Multi-Year Upstream Storage[5]	TCID (Rusty Jardine and Walt Winder, June 2011)	Unknown	Unknown	Unknown

Note:

[1] Field cost is an estimate of capital costs of a feature or project from award to construction closeout, but does not represent total construction costs, which are the sum of field costs and non-contract costs. Allowances for mobilization, design contingencies, procurement strategies, and construction contingencies are included in field cost. Non-contract costs are not included in the field cost; some cost estimate sources reported construction costs and were adjusted to reflect field costs by removing non-contract costs outlined in the cost estimate. Non-contract costs refer to costs of work or service provided in support of the Project, and other work that can be attributed to the Project as a whole, known as distributed costs, which include facilitating services, investigations, design and specifications, construction management, environmental compliance, and archeological considerations. Costs not developed by MWH were indexed to January 2012 using Reclamation's Construction Cost Trends (Reclamation 2012).

[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life. Typically, interest and amortization is determined using total capital costs (construction cost plus interest during construction); however, total capital costs were not available. Operation and maintenance (O&M) costs are included in the annual costs and are typically expressed as a percentage of the field or construction cost for preliminary and/or appraisal level estimates. O&M costs estimated at source price level were indexed to January 2012 using Reclamation's Construction Cost Trends (Reclamation 2012).

[3] These are not field costs and only represent a portion of non-contract costs related to land acquisition.

[4] Yield for this measure represents the volume of water that is delivered to agricultural users via the Truckee Canal, but will need to be delivered through an alternate conveyance for alternatives that consider decommissioning the Truckee Canal.

[5] Measure is retained in concept only and will *not* be used in any preliminary or final Study alternative (see Appendix D6).

Key:

AF = acre-foot

NA = not applicable

TAF = thousand acre feet

TBD = to be determined

TC = Truckee Canal lateral

Table 4-3. Water Supply Measures Not Retained for Use in Preliminary Alternatives

Category	Subcategory	Measure	Phase of Elimination During Measures Screening	Rationale for Status
Develop Alternative Sources	Replace Truckee Canal Supply	Construct Carson River Pipeline to Serve Agricultural Users	Phase 1	High institutional barriers to implementation.
		Develop Local Groundwater to Serve Agricultural Users	Phase 1	Conflicts with current Nevada laws and regulations.
		Develop Local Groundwater to Supply Stockwater	Phase 1	Conflicts with current Nevada laws and regulations, low anticipated contributions to water supply objective.
	Establish New Truckee Division Points of Diversion and Delivery	Construct Truckee River Intake and Pipeline to City of Fernley	Phase 3	Surface water diversion system to be planned and implemented separately by the City of Fernley. Field cost[1] is estimated at $8.9 million to $14 million. Annual cost[2] is estimated at $0.86 million to $1.35 million.
		Deliver from TC-1	Phase 3	Surface water diversion system to be planned and implemented separately by the City of Fernley. Field cost[1] is estimated at -$0.94 million to $1.25 million. Annual cost[2] is estimated at -$0.046 million to $0.061 million.
Develop or Use Upper Basin Storage	Access Truckee River Storage	Deliver TCID Supplies from Donner Lake	Phase 2	High institutional barriers to implementation.
	Increase Storage in the Upper Carson Basin	Construct East Fork Carson Reservoir	Phase 1	Unlikely contributions to meeting water supply objective, high institutional barriers to implementation, and large potential environmental concerns.
		Expand or Dedicate Existing Carson Reservoirs	Phase 2	Uncertain contributions to meeting the water supply objective and high institutional barriers to implementation.
Improve Carson River Supplies	Improve Storage Below Lahontan Dam	Dredge or Reshape Sheckler Reservoir	Phase 1	Low anticipated contributions to water supply objective.
		Storage at Naval Bombing Range	Phase 1	Low anticipated contributions to water supply objective and restrictions on non-military activities and public access at the potential storage site.
		Storage on Tribal Lands	Phase 1	Low anticipated contributions to water supply objective and minimal benefit to the overall Project.

Table 4-3. Water Supply Measures Not Retained for Use in Preliminary Alternatives (contd.)

Category	Subcategory	Measure	Phase of Elimination During Measures Screening	Rationale for Status
Improve Carson River Supplies (contd.)	Increase Lahontan Dam Storage	Open Carp Dam	Phase 2	Low anticipated contributions to water supply objective.
		Raise Dam	Phase 2	Low anticipated contributions to water supply objective.
		Retrofit or Improve Flashboards	Phase 2	Low anticipated contributions to water supply objective.
	Reduce Diversions from Upper Carson Basin	Change Enforcement of Alpine Decree	Phase 2	High institutional barriers and uncertain contributions to meeting the water supply objective.
		Purchase and Retire Upper Carson River Rights	Phase 2	Low anticipated contributions to water supply objective.
Increase Efficiency	Improve Carson Division Delivery Operations	Automate/Telemeter Structures	Phase 1	Uncertain contributions to meeting water supply objective.
		Community Rotation System	Phase 1	Low anticipated contributions to water supply objective.
		Drain Canals in Non-Irrigation Seasons	Phase 1	Appears to be in practice already. Low anticipated contributions to water supply objective.
		Improve Ditch Rider Training	Phase 1	Uncertain contributions to meeting water supply objective.
		Meter or Calibrate Checks and Takeouts	Phase 1	Majority of volume delivered is metered already. Low anticipated contributions to water supply objective.
		Reuse Agricultural Drain Water	Phase 2	Low anticipated contributions to water supply objective.
	Improve Truckee Division Delivery Operations	Automate Derby Dam and Check Structures	Phase 1	Low direct contributions to meeting water supply objective.
	Reduce Carson Division Seepage	Compact Regulating Reservoir Beds	Phase 3	High cost and low anticipated contributions to water supply objective. Annual yield is estimated at 3,960 AF. Field cost[1] is estimated at $14.5 million to $29 million. Annual cost[2] is estimated at $3.3 million to $6.7 million.
		Line Regulating Reservoirs	Phase 3	High cost and low anticipated contributions to water supply objective. Annual yield is up to 4,400 AF. Field cost[1] is estimated at $58 million to $100 million. Annual cost[2] is estimated at $2.8 million to $4.9 million.
		Replace Main Canals and Laterals with Pipes	Phase 1	High anticipated implementation costs.

Table 4-3. Water Supply Measures Not Retained for Use in Preliminary Alternatives (contd.)

Category	Subcategory	Measure	Screening Phase of Elimination	Rationale for Status
Increase Efficiency (contd.)	Reduce Truckee Division Seepage	Compact Soil Lining of Truckee Canal Laterals	Phase 2	Low anticipated cost effectiveness.
		Line Truckee Canal Laterals	Phase 2	Low anticipated cost effectiveness.
		Replace Truckee Canal Laterals with Pipes	Phase 2	Low anticipated cost effectiveness.
		Replace Truckee Canal with Pipes	Phase 2	Low anticipated cost effectiveness.
Reduce Agricultural Demand	Improve On-farm Efficiency	Laser-level Fields	Phase 1	Low anticipated contributions to water supply objective.
		Transition to Sprinkler Technology	Phase 2	Low anticipated cost effectiveness. Field cost[1] is estimated at $110 million. Annual cost[2] is estimated at $11 million.
	Incentivize Reductions in Demand	Base Fees on Cost of Delivery	Phase 2	Low anticipated contributions to water supply objective.
		Base Fees on Volume Used	Phase 2	Low anticipated contributions to water supply objective.
		Establish Fees for Stockwater Delivery	Phase 2	Low anticipated contributions to meeting water supply objective and to potential conflicts with Project water rights.
		Subsidize Crop Conversions	Phase 1	Implementation challenges.
	Lease or Transfer Water Rights	Lease Water Rights	Phase 1	Uncertain contributions to meeting water supply objective.
		Transfer Water Rights	Phase 1	Politically and publicly unacceptable.
	Modify Land Uses	Purchase and Retire Strategic Parcels	Phase 2	Politically and publicly unacceptable.
		Subsidize Relocation of Properties to Consolidate Project	Phase 2	Implementation challenges.

Table 4-3. Water Supply Measures Not Retained for Use in Preliminary Alternatives (contd.)

Notes:

[1] Field cost is an estimate of capital costs of a feature or project from award to construction closeout, but does not represent total construction costs, which are the sum of field costs and non-contract costs. Allowances for mobilization, design contingencies, procurement strategies, and construction contingencies are included in field cost. Non-contract costs are not included in the field cost; some cost estimate sources reported construction costs and were adjusted to reflect field costs by removing non-contract costs outlined in the cost estimate. Non-contract costs refer to costs of work or service provided in support of the Project, and other work that can be attributed to the Project as a whole, known as distributed costs, which include facilitating services, investigations, design and specifications, construction management, environmental compliance, and archeological considerations. Costs not developed by MWH were indexed to January 2012 using Reclamation's Construction Cost Trends (Reclamation 2012).

[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life. Typically, interest and amortization is determined using total capital costs (construction cost plus interest during construction); however, total capital costs were not available. Operation and maintenance (O&M) costs are included in the annual costs and are typically expressed as a percentage of the field or construction cost for preliminary and/or appraisal level estimates. O&M costs estimated at source price level were indexed to January 2012 using Reclamation's Construction Cost Trends (Reclamation 2012).

[3] These are not field costs and only represent a portion of non-contract costs related to land acquisition.

Key:

AF = acre-foot

TCID = Truckee-Carson Irrigation District

Descriptions of Retained Water Supply Measures

The measures included in summary in Table 4-2 were all retained for potential use in the Study's preliminary alternatives because they were judged to offer large contributions toward meeting the Study's water supply objective. The sections below summarize the concept for each measure and also explain why each was retained.

The analyses supporting many of the determinations below appear in Appendix D1 through D7 to this report. Appendix E1, "Consideration of Measures for Water Supply Objective," contains descriptions for the full set of measures identified and evaluated during the Study.

Project-wide Measures

The majority of the measures considered by the Study could either apply to, or affect, the entire Project's water supply reliability. These measures were not intended to target a specific division of the Project, although they may apply to or logically fit better with one division over another due to the different characteristics of each.

Import Dixie Valley Groundwater

Measure Category: Develop Alternative Sources
Measure Subcategory: Supplement Carson Division Supply
Location in Appendix E1: Page E-1-8
Retained for Flow Stages: 0 cfs, 150 cfs, 250 cfs, and 350 cfs

This measure considers delivering groundwater from Dixie Valley for use in the Carson Division and is based on a proposal developed and studied by Churchill County. This measure includes a range of actions depending on the desired capacity (5,000 – 11,000 gpm) for facilities to deliver Dixie Valley supplies into the Lahontan Valley. Construction of several facilities would be required, including a pressurized pipeline that would cross over Sand Pass adjacent to Highway 50, groundwater wells, one or several large-scale pumping plants, a treatment facility to remove arsenic and fluoride, electrical transmission lines (Churchill County 2007).

Pumping Dixie Valley's groundwater into the Lahontan Valley could contribute to the water supply objective of this Study by augmenting supply for the Carson Division in all years, effectively reducing the total Project demand supplied from the existing Project.

Line (Carson Division) Main Canals and Laterals

Measure Category: Increase Efficiency
Measure Subcategory: Reduce Carson Division Seepage
Location in Appendix E1: Page E-1-40
Retained for Flow Stages: 0 cfs, 150 cfs, 250 cfs, and 350 cfs

This measure considers the installation of a 4-inch concrete lining with a geomembrane liner to prevent seepage along up to 55 miles of conveyance facilities in the Carson Division. This measure only considers lining the main canals and laterals where seepage losses are greatest, based on conclusions of the *Newlands Project Efficiency Study* (Efficiency Study, Reclamation 1994). “Appendix C” to the Efficiency Study evaluated three possible extents for lining canals and laterals to improve conveyance efficiency in the Carson Division: “Option 1” proposes lining portions of the V, S, L, and A canals; “Option 1 Expanded” increases the extent beyond Option 1 by also lining portions of the S Canal and L1 lateral; and “Option 1 Expanded plus T Canal” increases the extent beyond Option 1 Expanded by also lining portions of the T Canal (see Table 4-4).

Table 4-4. Extent of Carson Division Canal Rehabilitation Considered for Study

1994 Efficiency Study Option	Extent of Canal Improvement
Option 1	34.3 miles
Option 1 Expanded	44.9 miles
Option 1 Expanded plus T Canal	54.5 miles

Source: Reclamation 1994

The “Option 1 Expanded” lining approach was retained for its potential to increase Project conveyance efficiency. By reducing the amount of water that is lost due to seepage within the Carson Division, this measure would make more efficient use of water stored at Lahontan Reservoir, effectively augmenting the division’s supply. The amount of seepage reduced may vary, depending on the lining option selected and the total volume of deliveries to the Carson Division.

Compact Soil Lining of (Carson Division) Main Canals and Laterals

Measure Category: Increase Efficiency
Measure Subcategory: Reduce Carson Division Seepage
Location in Appendix E1: Page E-1-38
Retained for Flow Stages: 0 cfs, 150 cfs, 250 cfs, and 350 cfs

This measure considers vibratory compaction techniques to compress the upper 2 feet of soil in the Carson Division’s earth-lined canals and laterals to reduce seepage losses. This measure only considers compacting the main canals and laterals, where seepage losses are greatest, based on conclusions of the Efficiency Study (Reclamation 1994). Although the Efficiency Study did not include compaction options for seepage reduction, this Study is considering it as a potentially lower cost alternative to concrete geomembrane lining. The Study selected three possible extents for implementing a soil compaction measure to reduce seepage from the Carson Division’s canals and laterals; each is based on an option for canal/lateral lining that was originally evaluated by the Efficiency Study, and is described in Table 4-4 above.

Unlike the preceding canal lining measure, both “Option 1 Expanded” and “Option 1 Expanded plus T Canal” compaction extents were retained to account for the uncertain effectiveness of compaction techniques in the Carson Division. Previous studies have concluded that *in situ* vibratory compaction performed on agricultural canals with predominantly sandy loam soils can reduce seepage losses by up to 90 percent (Burt et al. 2010); however, the extent of seepage reductions has not been specifically verified in the Project boundaries.

By reducing the amount of water that is lost due to seepage within the Carson Division, this measure would make more efficient use of water stored at Lahontan Reservoir, effectively augmenting the division’s supply. The amount of seepage reduced may vary, depending on the compaction option selected and the total volume of deliveries to the Carson Division.

Line Truckee Canal

Measure Category: Increase Efficiency
Measure Subcategory: Reduce Truckee Division Seepage
Location in Appendix E1: Page E-1-46
Retained for Flow Stages: 250 cfs and 350 cfs

This measure considers lining the Truckee Canal with an impermeable geomembrane covered by unreinforced concrete, as described in the section of this chapter titled “Measures Identified for Achieving Safe Operations of the Truckee Canal” and in Table 4-1. In addition to reducing seepage losses, this measure would help resolve some of the canal's structural problems caused by animal burrowing. By reducing seepage losses from the Truckee Canal, lining would contribute significantly to meeting the water supply objective.

The total volume of seepage losses may vary, depending on total volume of deliveries through the Truckee Canal; however, it is estimated that the lining option recommended as a safety measure would achieve an 85 percent reduction from current seepage levels.

At flow stages of 250 cfs and 350 cfs, lining the Truckee Canal would both achieve the safety objective and contribute significantly toward achieving the water supply objective.

Compact Soil Lining of the Truckee Canal

Measure Category: Increase Efficiency
Measure Subcategory: Reduce Truckee Division Seepage
Location in Appendix E1: Page E-1-44
Retained for Flow Stages: 150 cfs

This measure considers vibratory compaction techniques to compress the upper 2 feet of soil in the earth-lined portions of the Truckee Canal, and also includes construction activities along the entire structure. By reducing seepage losses from the Truckee Canal, compaction would help meet the water supply objective.

Soil compaction is retained only for alternatives with an active Truckee Canal, but without structural integrity improvements along the length of the canal; compaction performs a similar function to lining. It could not be used in conjunction with a cutoff wall due to potential damage to the structure during the compaction process.

Previous studies have concluded that in-situ vibratory compaction performed on agricultural canals with predominantly sandy loam soils can reduce seepage losses by up to 90 percent (Burt et al. 2010); however, the extent of seepage reductions has not been specifically verified for the Truckee Canal.

Acquire and Retire Water Rights

Measure Category: Reduce Agricultural Demand
Measure Subcategory: Modify Land Uses
Location in Appendix E1: Page E-1-59
Retained for Flow Stages: 0 cfs, 150 cfs, 250 cfs, and 350 cfs

This measure seeks to retire a sufficient volume of water rights that the remaining Newlands Project water rights can be considered reliable. Water rights would be obtained from willing sellers and would then be retired from production thereby reducing the volume of shortage experienced by the Project's remaining water rights holders.

Unlike some of the other water supply measures, the ability of water rights acquisitions to meet the water supply objective is almost entirely contingent on the level of participation by willing sellers. However, if sufficient funding and willing sellers exist, it represents a significant and direct mechanism for meeting the Study's water supply objective. There may be an opportunity to apply this measure in a manner that also contributes to the goals of the USFWS Water Rights Acquisition Program for Lahontan Valley Wetlands, if the USFWS program has not yet achieved its goals by the time that a Study alternative is implemented.

Crop Insurance/Fallowing

Measure Category: Reduce Agricultural Demand
Measure Subcategory: Reduce Dry-Year Demand
Location in Appendix E1: Page E-1-61
Retained for Flow Stages: 0 cfs, 150 cfs, 250 cfs, and 350 cfs

This measure considers compensating water rights holders for lost production if they agree not to exercise their rights during drier years. It would help reduce Project demand during years when deliveries from the Truckee Canal are needed to supplement low water levels in Lahontan Reservoir, which could help ensure that Project water rights holders receive water reliably, even under conditions that include a lower flow in the Truckee Canal.

As with “Acquire and Retire Water Rights,” the success of crop insurance/fallowing in helping to meet the water supply objective is contingent the level of participation by willing individuals, as well as the extent of land that is temporarily pulled out of production. Similar voluntary demand reduction programs have seen a maximum participation rate of about 30 percent. As such, this Study assumes 30 percent as a maximum for potential participation, although actual participation rates could be much lower given that the program would be voluntary and might vary considerably year-to-year.

Partial Season Forbearance Agreements

Measure Category: Reduce Agricultural Demand
Measure Subcategory: Reduce Dry-Year Demand
Location in Appendix E1: Page E-1-63
Retained for Flow Stages: 0 cfs, 150 cfs, 250 cfs, and 350 cfs

This measure would compensate water rights holders to end irrigation and crop production earlier during drier years than they ordinarily would. This effectively shortens the irrigation season for many farmers. The terms, conditions, and payment for exercising this option would be preestablished in individual forbearance agreements before the irrigation season began. As with “Crop Insurance/Fallowing,” this measure would help reduce Project demand during years when deliveries from the Truckee Canal are needed to supplement low water levels in Lahontan Reservoir, which could help ensure that Project water rights holders receive water reliably even under conditions that include a lower flow in the Truckee Canal.

As with “Acquire and Retire Water Rights” and “Crop Insurance/Fallowing,” the success of partial season forbearance agreements in helping to meet the water supply objective is contingent on the level of participation by willing individuals, as well as the terms of the agreements and the extent of the land subject to the agreements. Like “Crop Insurance/Fallowing,” the maximum potential participation is assumed to be 30 percent.

Multi-Year Upstream Storage

Measure Category: Develop or Use Upper Basin Storage
Measure Subcategory: Access Truckee River Storage
Location in Appendix E1: Page E-1-17

This measure would allow Newlands Project supplies from the Truckee River (Claim 3 under the *Orr Ditch* Decree) to be stored in upstream reservoirs on the Truckee River (e.g., Prosser Reservoir) during periods when either the Truckee Canal or Lahontan Reservoir are incapable of capturing, storing, or delivering those supplies. It considers allowing those supplies to be held in upstream reservoirs as carry over from year-to-year until such a time that they could be delivered for the Project's use. In so doing, it helps the Project cope with a capacity-limited Truckee Canal by providing flexibility to divert Claim 3 water into the canal at Derby Dam at a time when conveyance to Project water users is possible.

Rationale for Retaining in Concept Only While physically possible, institutional arrangements do not exist to allow Truckee Canal water rights to remain in Truckee River reservoirs over multiple years. This Study finds that facilitating multi-year Project storage in upstream Truckee River reservoirs shows promise as the cheapest and most effective method for improving the reliability of Project water supplies, regardless of the Truckee Canal's capacity.

Currently, OCAP does not allow Project water rights holders to store water for multiple years in upstream Truckee River reservoirs for release and diversion through the Truckee Canal during drier years. TROA – which is not yet implemented – does allow its signatories considerable flexibility to exchange water supplies and storage space to ensure water is available when needed for human and environmental uses; however, Newlands Project water rights holders are not signatories to TROA. To implement this measure, an agreement would likely need to be negotiated separately among TCID, Reclamation, and one or more signatories to TROA, such as TMWA or the Pyramid Lake Paiute Tribe. Given the ultimate withdrawal of TCID from the TROA negotiations, and the large number of ongoing TROA-related lawsuits, appears to be institutionally difficult at this time.

The institutional barriers that currently prevent multi-year storage by the Project also prevent a comprehensive evaluation of its potential. However, this Study conducted preliminary assessment to test its broad applicability to the Study's water supply objective, which is described in Appendix D6, "Potential Opportunities to Store Newlands Project Water in Truckee River Reservoirs." An appropriate technical evaluation would require the development of computer logic describing very specific constraints on such a storage program. The development of an appropriate framework of constraints would require the willing participation of several stakeholders, most of whom are already TROA signatories. Without such participation, development of specific constraints by this Study would have been highly speculative, and would not have produced helpful results.

Institutional complications aside, the Study's evaluation of the measure suggests that it is technically possible to reduce considerable volumes of Project shortages through the multi-year storage of Project water in upstream Truckee River reservoirs. Given that this requires institutional agreements, and not construction, this measure appears to be high-value and low-cost solution for satisfying the Study's water supply objective. The potential value of this measure leads the Study to retain the measure, but the uncertainty surrounding the necessary institutional agreements needed to facilitate its implementation leads the Study to retain multi-year storage "in concept only." As such, this measure will not be used in either preliminary or final Study alternatives.

Truckee Division-Specific Measures

A certain subset of measures apply to the Project's Truckee Division, only. These, along with others not selected for use in preliminary alternatives, were identified specifically to serve the water rights (agricultural and M&I) of the Truckee Division under alternatives that include measures which would reduce the majority of seepage from the Truckee Canal or decommission the structure from future use.

Construct Pipeline to Agricultural Users

Measure Category: Develop Alternative Sources
Measure Subcategory: Establish New Truckee Division Points of Diversion and Delivery
Location in Appendix E1: Page E-1-10
Retained for Flow Stages: 0 cfs and 150 cfs (with "Compact Soil Lining of the Truckee Canal")

This measure serves agricultural water rights in the Truckee Division from the Truckee River. It includes construction of a 50 cfs, 1,700-horsepower pump station and pipeline (approximately 18.3 miles) to convey these supplies to the head works of the current distribution laterals (TC-01 to TC-13). For alternatives where the Truckee Canal capacity is limited, this measure increases the capacity available for conveyance to Lahontan Reservoir. For alternatives where the Truckee Canal's flow stage is 0 cfs, this measure serves rights within the Truckee Division without conveying water through the Fernley Reach.

This measure could be combined with the measure to serve agriculture in the Fernley area from treated effluent ("Treat Effluent and Deliver for Agricultural Use").

Treat Effluent and Deliver for Agricultural Use

Measure Category: Develop Alternative Sources
Measure Subcategory: Supplement Truckee Division Supply
Location in Appendix E1: Page E-1-6
Retained for Flow Stages: 0 cfs

This measure serves agricultural water rights in the Truckee Division with a supplemental supply of water derived from treated wastewater from the City of Fernley's East Wastewater Treatment Facility. The facility is a secondary treatment plant with a current average treatment volume of 1.5 million gallons per day (City of Fernley 2008b). At present, there are no plans for the City of Fernley to reuse treated wastewater, and it is discharged to the Fernley Wildlife Management Area and infiltrated into the local aquifer. Modifications would be required to the current treatment process to provide a higher level of filtration and disinfection (similar to California Title 22 drinking standards) for stockwater use or use on agricultural fields. Depending on the actual use, for instance if all supplies are applied to fields and not applied to stock, then the current level of treatment could be sufficient and the additional cost of tertiary treatment may be avoided. This measure would also require a conveyance equivalent to the "Construct Pipeline to Agricultural Users" measure for the Truckee Division. Using treated effluent as an alternative water supply source was retained because it offers the possibility to meet one-quarter of the anticipated maximum future demand from Truckee Division's agricultural users.

Process for Developing Preliminary Alternatives

Preliminary alternatives have been assembled under the range of Truckee Canal flow-stage conditions (600 cfs, 350 cfs, 250 cfs, 150 cfs, and 0 cfs) for meeting the safety objective. As discussed above, the first step in developing preliminary alternatives is conducting an assessment of the water supply performance of the Newlands Project at each flow stage absent other measures; this is called the reference scenario. Water supply performance is measured relative to a Desired Reliability scenario that represents the desired water supply conditions for the Project.

Comparison of Water Supply Conditions

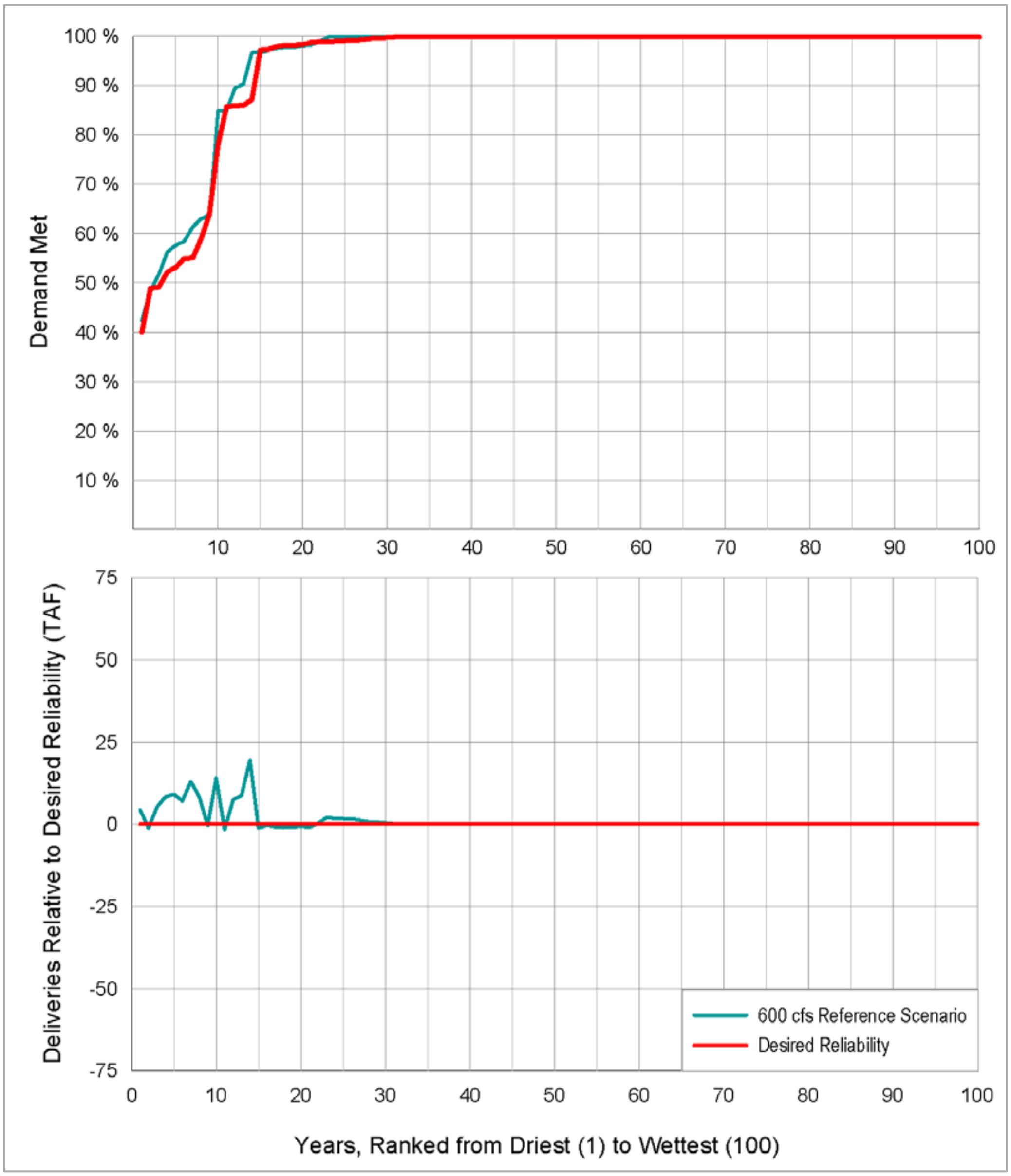
The following sections present water supply reliability at each flow-stage reference scenario relative to the Desired Reliability in two ways. In the first figure for each flow stage, the annual water supply condition for each scenario is simulated for a 100-year period. These years are ranked by the percent of Project demand met, from the driest years to the wettest years, and plotted to compare the frequency and magnitude of water supply shortages (conditions in which not all of the demands were met). The percent of Project demands met differs for all the scenarios, and those differences provide a basis for assessing water supply reliability for the Study at each flow stage.

In the second figure for each flow-stage scenario, the differences in demand met between the flow-stage reference scenario and the Desired Reliability scenario (expressed as a percentage met in the first figure) are translated into a volume. The translation from percent difference to volume considers the likely future Project demand in the reference scenario so that the second figures reveal the volume of demand that would need to be developed to meet or exceed the Desired Reliability scenario.

More complete characterizations and comparisons of the reference and Desired Reliability scenarios are provided in Appendix D1.

Water Supply Conditions for the 600 cfs Reference Scenario

As shown in Figure 4-3, significant water supply shortages occur for both scenarios in the driest years, but the 600 cfs reference scenario has a very similar percent and volume of demand met when compared to the Desired Reliability scenario for the full range of water supply conditions.

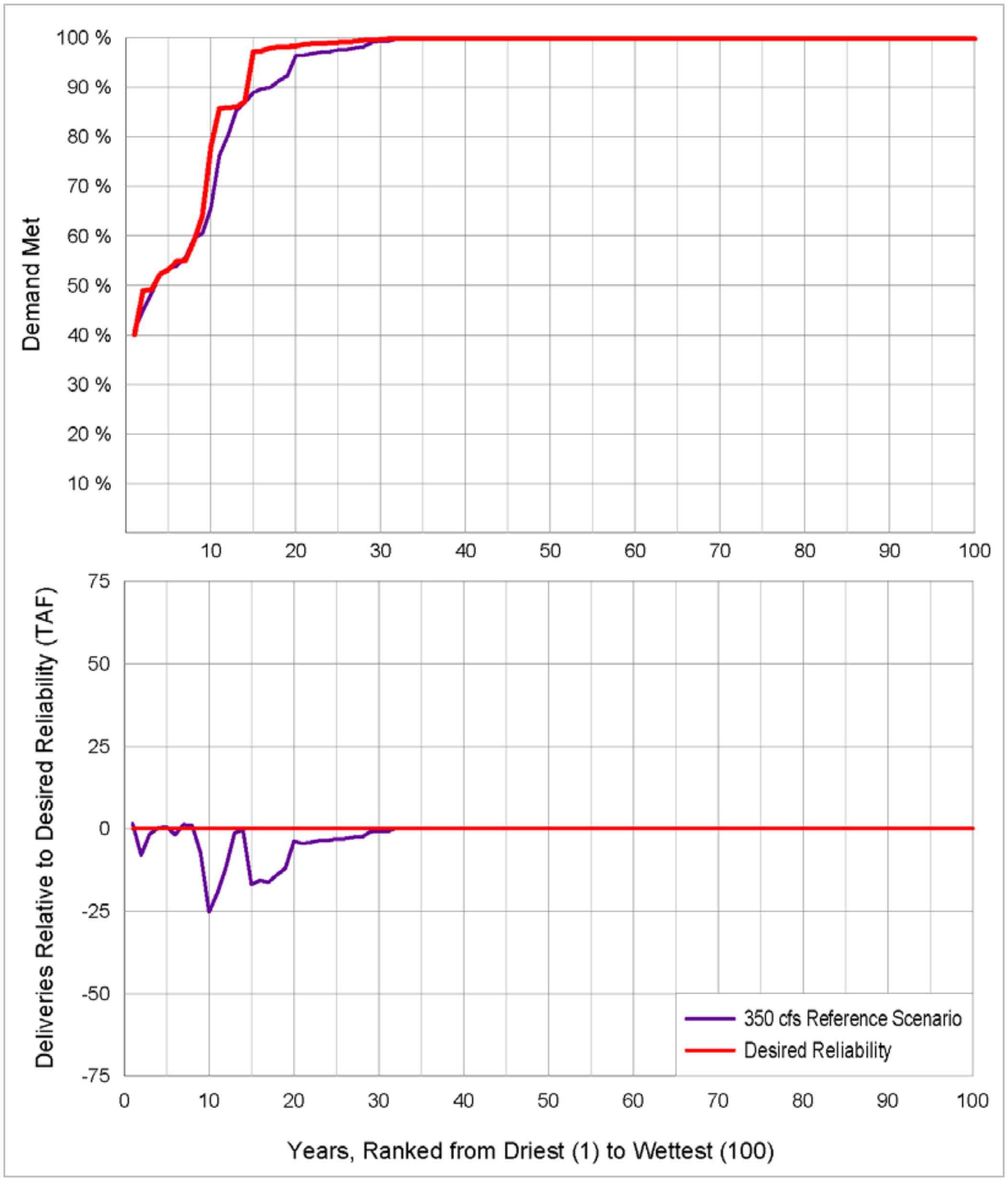


Key: cfs = cubic feet per second

Figure 4-3. Relative Performance of Truckee Canal 600 cfs Flow-Stage Reference Scenarios on Annual Newlands Project Deliveries

Water Supply Conditions for the 350 cfs Reference Scenario

As demonstrated in Figure 4-4, the 350 cfs flow-stage reference scenario provides a level of water supply reliability that, essentially, equals the Desired Reliability in the driest 10 years or the wettest 70 years. However, reliability falls as much as 12 percent below the Desired Reliability condition for approximately 20 of the 100 years evaluated. In the bottom graph, with the total delivery volume under the Desired Reliability as a baseline, the 350 cfs reference scenario results in a net shortage of 176,000 acre-feet over the period of evaluation.

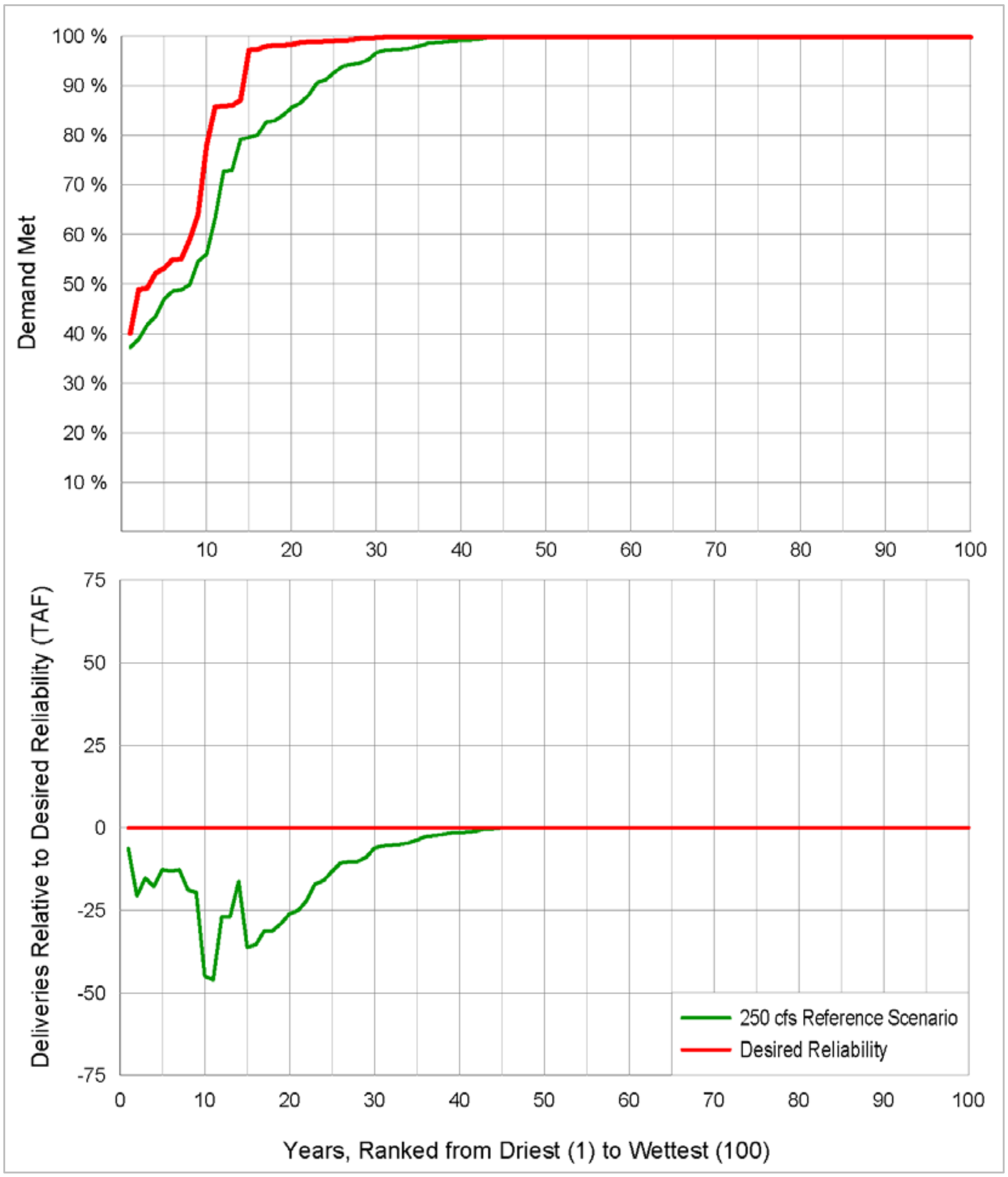


Key: cfs = cubic feet per second; TAF = thousand acre-feet

Figure 4-4. Relative Performance of Truckee Canal 350 cfs Flow-Stage Reference Scenarios on Annual Newlands Project Deliveries

Water Supply Conditions for the 250 cfs Reference Scenario

As demonstrated in Figure 4-5, the 250 cfs flow-stage reference scenario provides a level of reliability that only meets the Desired Reliability in 55 years of the 100 years evaluated. Reliability falls as much as 22 percent below the Desired Reliability condition in approximately 45 of the 100 years evaluated. In the bottom graph, with the total delivery volume under the Desired Reliability as a baseline, the 250 cfs reference scenario results in a net shortage of 660,000 acre-feet over the period of evaluation.

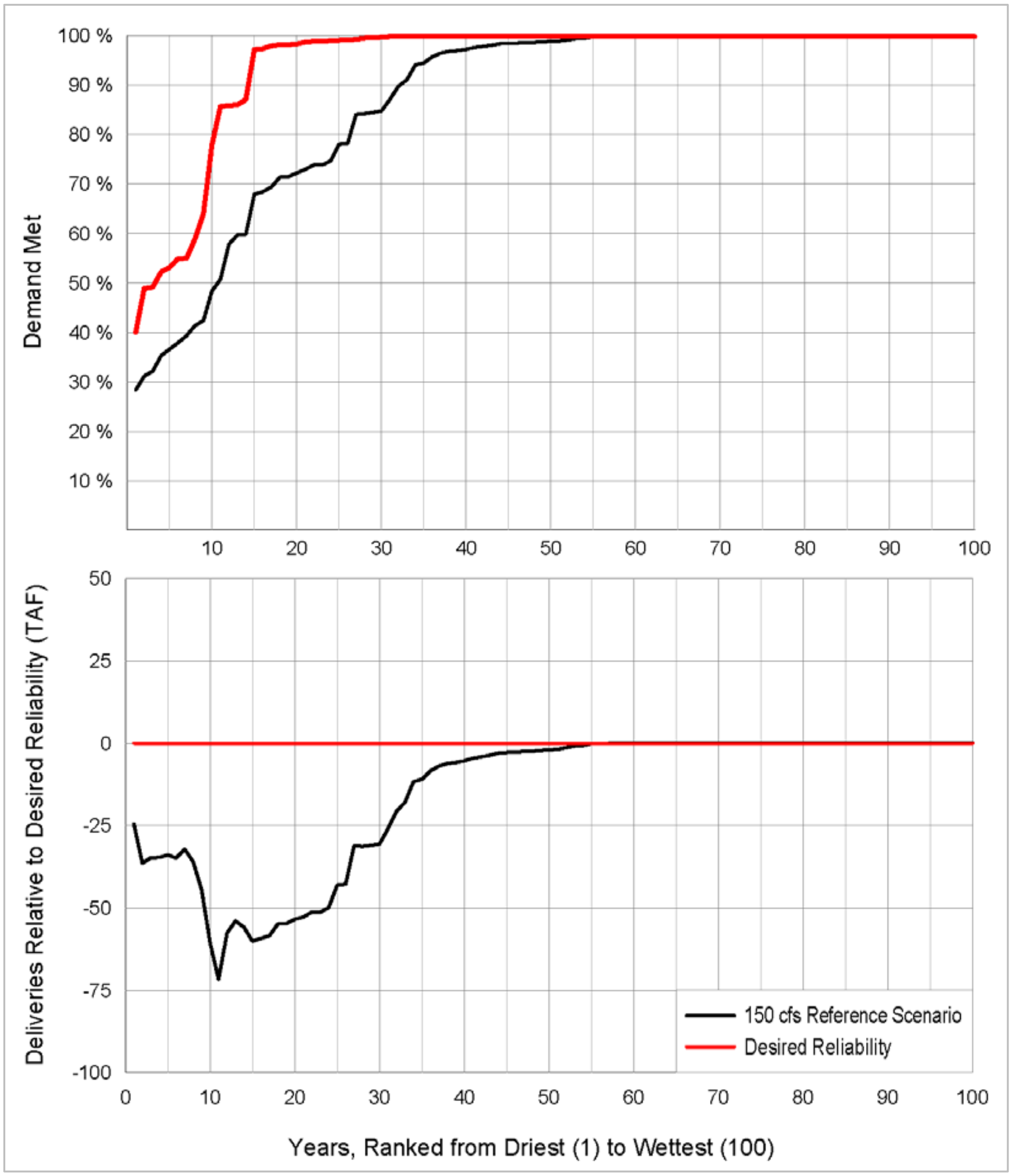


Key: cfs = cubic feet per second; TAF = thousand acre-feet

Figure 4-5. Relative Performance of Truckee Canal 250 cfs Flow-Stage Reference Scenarios on Annual Newlands Project Deliveries

Water Supply Conditions for the 150 cfs Reference Scenario

As demonstrated in Figure 4-6, the 150 cfs flow-stage reference scenario provides a level of reliability that only meets the Desired Reliability in 45 years of the 100 years evaluated. Reliability falls as much as 35 percent below the Desired Reliability condition for approximately 55 years of the 100 years evaluated. In the bottom graph, with the total delivery volume under the Desired Reliability as a baseline, the 150 cfs reference scenario results in a net shortage of 1,519,000 acre-feet over the period of evaluation.



Key: cfs = cubic feet per second; TAF = thousand acre-feet

Figure 4-6. Relative Performance of Truckee Canal 150 cfs Flow-Stage Reference Scenarios on Annual Newlands Project Deliveries

Water Supply Conditions for the 0 cfs Reference Scenario

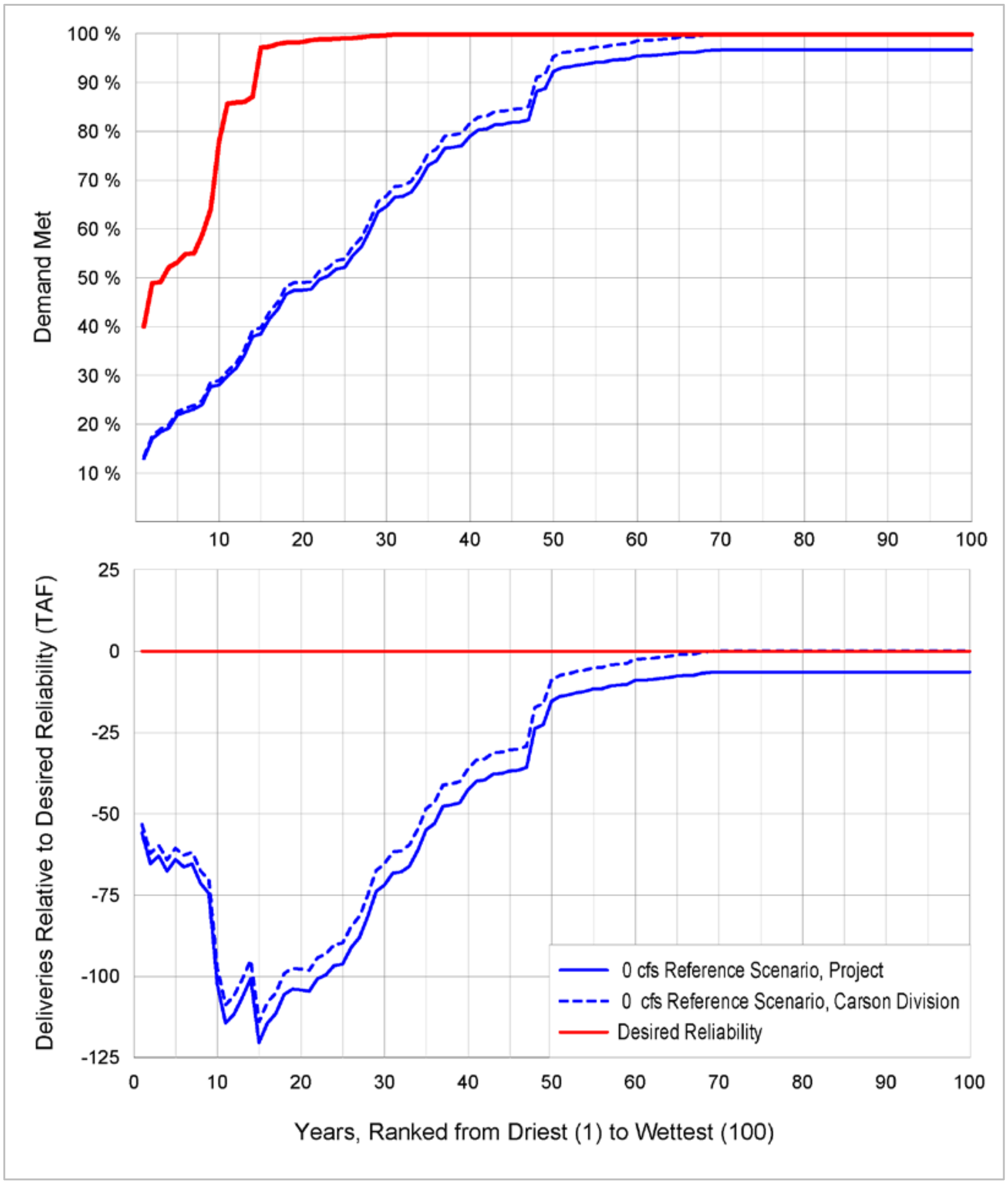
In contrast to the previous 4 figures, the graphs shown below (Figure 4-7) for the 0 cfs reference scenario consider both the Newlands Project (solid line) and, separately, the Carson Division (dashed line) in examining water supply reliability. This is because the 0 cfs scenario assumes decommissioning of the Truckee Canal, in which case demand would never be met in the Truckee Division.

However, even with the decommissioning of the Truckee Canal, the Carson Division would still receive water supply from the Carson River. The analysis of the performance of the Carson Division-only 0 cfs reference scenario, therefore, considers only the reliability of the Carson Division.

The Desired Reliability curves for the entire Project and for the Carson Division are nearly identical; as such, and to avoid confusion, the Desired Reliability does not change for Figure 4-7, and is the same curve used throughout the Study.

For the Truckee Division, the 0 cfs reference scenario meets 95 percent of the demand in 40 of the 100 years evaluated. The 3 percent gap between the Desired Reliability and the Project-wide 0 cfs reference scenario curves, even during the wettest years, represents Truckee Division's unmet demand due to the loss of the Truckee Canal. Consequently, an alternative source or delivery system will be included for the Truckee Division under any 0 cfs flow-stage alternative developed for this Study.

For the Carson Division, the 0 cfs flow-stage reference scenario provides a level of reliability that falls well below the Desired Reliability scenario for all but about 35 years of the 100 years evaluated. Reliability falls as much as 57 percent below the Desired Reliability for approximately 65 of the 100 years evaluated. In the bottom graph, with the total delivery volume under the Desired Reliability as a baseline, the 0 cfs reference scenario results in a net shortage of 3,344,000 acre-feet over the period of evaluation.

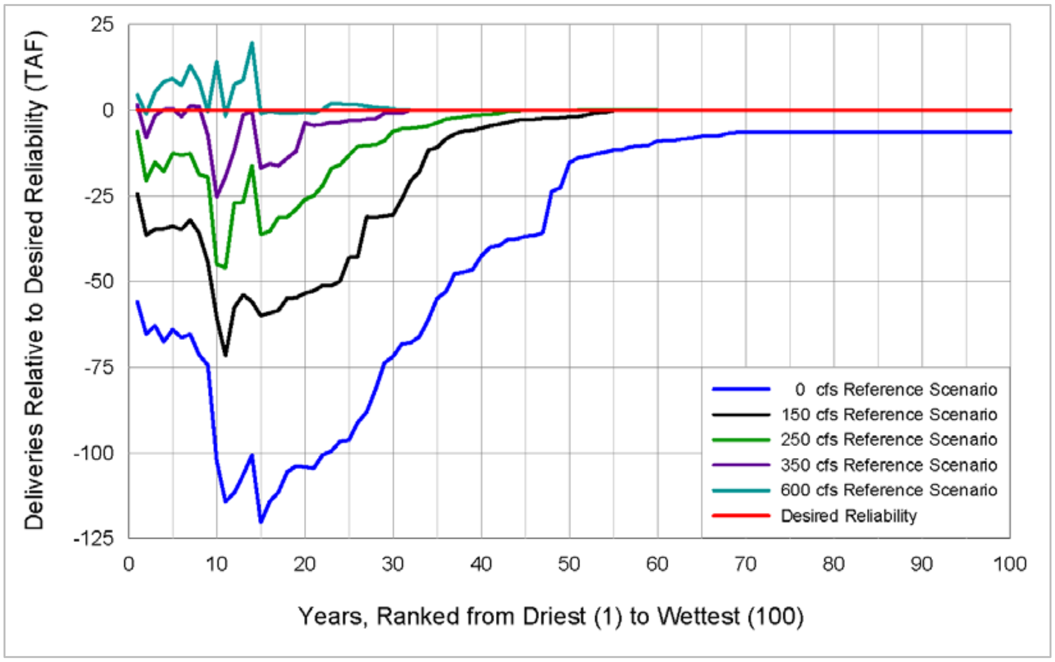


Key: cfs = cubic feet per second; TAF = thousand acre-feet

Figure 4-7. Relative Performance of Truckee Canal 0 cfs Flow-Stage Reference Scenarios on Annual Project Deliveries

Effectiveness of Measures Retained for Meeting Water Supply Objective

Preliminary alternatives were designed based upon the extent of remaining water supply improvement needed for a given flow-stage condition and by the extent of water supply improvement offered by the various measures retained after screening. Figure 4-8 illustrates the differences in annual water supply volumes between the Desired Reliability scenario and the range of Truckee Canal flow-stage reference scenarios, which represents the remaining water supply need under those conditions.



Key: cfs = cubic feet per second; TAF = thousand acre-feet

Figure 4-8. Summary of Differences Between the Desired Reliability and Reference Scenarios, Expressed in Volume

The following sections characterize the water supply benefits for the 11 measures retained and used in the development of preliminary alternatives. The characterization of these measures is organized by the subcategory for each measure.

Measures that Reduce Seepage Losses from the Truckee Canal

Two measures were retained from the subcategory “Reduce Truckee Division Seepage”: canal lining (“Line Truckee Canal”) and compaction (“Compact Soil Lining of the Truckee Canal”). Neither of these would completely eliminate losses from the Truckee Canal, but a significant reduction would be expected in portions of the canal where the soil was lined with concrete or compacted. As such, the evaluation of these measures for preliminary alternatives assumed that losses from the Truckee Canal would be reduced by 85 percent for lining and compaction (see Appendix D2).

For flow stages of 350 and 250 cfs, the measure available for reducing seepage from the Truckee Canal involves selecting the safety measure that implements a concrete liner for the Truckee Canal. For 350 cfs, the reduction of losses from the Truckee Canal appears to satisfy the water supply objective and result in a level of reliability that is equivalent to the Desired Reliability scenario. The reduction of losses brings 250 cfs closer to the Desired Reliability level, but it is still below the level of reliability for the 350 cfs reference scenario without lining.

For a flow stage of 150 cfs, the measure available for reduction of seepage losses on the Truckee Canal involves compacting the earthen embankments. The compaction measure improves Project water supply conditions for a flow stage of 150 cfs, but does not meet the Study's water supply objective.

Measures that Supply the Truckee Division

Two measures were retained from the subcategories "Establish New Truckee Division Points of Diversion and Delivery" and "Supplement Truckee Division Supply" to be used in combination with any measures that significantly reduce or eliminate seepage from the Truckee Canal or decommission all or most of the Truckee Canal from use. The retained measures include:

- Construction of a pipeline from the TC-1 takeout or from a direct Truckee River diversion along the length of the Truckee Canal through to Swingle Bench and Hazen, for serving Truckee Division agricultural water rights ("Construct Pipeline to Agricultural Users")

- Treatment of wastewater from the City of Fernley to a standard appropriate for serving Truckee Division agricultural water rights ("Treat Effluent and Deliver for Agricultural Use")

Construction of a pipeline along the length of the existing Truckee Canal right-of-way would be required for supplying Truckee Division agricultural rights for the 0 cfs flow-stage condition.

The treatment of City of Fernley wastewater could provide 1.5 million gallons per day, or 1,700 acre-feet per year of water supply. This would reduce demand for agricultural diversions in the Truckee Division by 26 percent, thereby reducing the size and operating costs of an on-river pump station. Depending on the intended application of the wastewater, upgrades could be required to the wastewater treatment plant.

Measures that Reduce Agricultural Demand Temporarily or Permanently

Three measures with similar performance characteristics were retained for the category "Reduce Agricultural Demand." These range from temporary dry-year demand reduction programs ("Crop Insurance/Fallowing" and "Partial Season Forbearance Agreements") to permanent water right retirement ("Acquire and Retire Water Rights"). All three have been evaluated with the same technical approach that can be applied both to temporary and permanent demand reduction programs (see Appendix D3). Dry year reduction programs, however, were assumed to be limited to reducing 30 percent of Project demands; reductions in demand above 30 percent would require permanent water right retirement.

The estimated proportion of demand reductions needed to match demand to the available water supply (or meet the water supply objective) under a range of flow-stage conditions are based on an analysis that was formulated to test the broad effects of demand reduction (see Appendix D3) on Project reliability. The large increments of demand considered do not lend themselves to precise recommendations for how much demand must be reduced to meet water supply under specific circumstances, particularly if demand reduction measures are combined with other types of measures to form alternatives. Thus, a range of potential demand reductions has been identified for consideration in preliminary alternatives, as shown in Table 4-5.

Table 4-5. Estimated Reduction in Project Demand Required to Fulfill the Water Supply Objective

Flow-Stage Condition	Required Reduction in Project Demand to Meet the Water Supply Objective Without Other Measures
600 cfs	0%
350 cfs	5 – 15 %
250 cfs	20 – 25%
150 cfs	35 – 45%
0 cfs (Carson Division)	70 – 80%
0 cfs (Truckee Division)	100%

Source: Appendix D3, "Effects of Reducing Demand on Newlands Project Water Supply."
Key:
cfs = cubic-foot per second

Demand reduction programs are measures that can be scaled up or down, as needed, and used alone or in conjunction with other measures to bring Project reliability closer to the Desired Reliability level at every flow stage. However, as these measures are dependent on willing participation, it may not be possible to provide a certain estimate for the degree of implementation that would occur.

Measures that Increase Conveyance Efficiency of the Carson Division

Two measures were retained from the subcategory for "Reduce Carson Division Seepage": canal lining and compaction. The potential extents of these measures in the Carson Division were developed as part of the Efficiency Study and are included in Table 4-4 (Reclamation 1994).

Lining and compaction differ in cost, performance, and maintenance requirements. Lining is more expensive, but also more durable; compaction was assumed to require frequent maintenance, but may be less expensive. The performance characteristics of these two measures would likely differ, requiring potentially larger implementation of the compaction measure (Option 1 Expanded plus T Canal, instead of Option 1 Expanded) to achieve the highest benefit. Both measures, however, have the potential to increase Project efficiency.

The evaluation of these measures for preliminary alternatives assumed the outcome of their implementation to result in a Project efficiency of 75 percent (see Appendix D4). This is based on the achievements of the Efficiency Study recommendations and on the current and expected future characteristics of the Project. Two basic alternatives were recommended in the Efficiency Study, each with its own blend of the following actions that would bring the Project to an estimated 75 percent efficiency: water rights retirement and/or transfers, large improvements in flow measurement and metering, and canal lining. Since that study was completed, multiple programs have succeeded in retiring around 10,000 acres of Project water rights; about 9,500 acres of water rights have been transferred to wetlands use, which receives a reduced duty (see Appendix C); and, by the end of 2012, flow measurement devices will have been installed that accurately measure 75 percent of the Project's delivery volume (TCID 2010; Rusty Jardine and Walt Winder, TCID, personal communications, August 23, 2011, and February 9, 2012). Given this progress on the Efficiency Study's recommendations, this Study assumes that the conveyance efficiency improvements in the Carson Division would help the Project achieve 75 percent efficiency.

For a flow stage of 350 cfs, increasing Project conveyance efficiency to 75 percent through lining or compaction would achieve a level of reliability that far surpasses the Desired Reliability; for a 250 cfs flow stage, reliability is roughly equivalent to the Desired Reliability. For a flow stage of 150 cfs, it substantially improves Project water supply conditions, but does not fully meet the water supply objective. The remaining portion of water supply has a frequency and magnitude similar to the 250 cfs flow-stage reference scenario. For a flow stage of 0 cfs, increasing Project efficiency to 75 percent improves Project water supply conditions by up to 20 percent in some years, but does not fully meet the water supply objective, and significant water supply shortages would remain.

Measures that Develop Alternative Sources of Supply for the Carson Division

The only measure from the "Supplement Carson Division Supply" subcategory, a measure to import Dixie Valley groundwater, was retained. Dixie Valley, if developed, would supply an estimated 35,000 acre-feet of supply per year, which would meet about 16 percent of the anticipated maximum annual Project demand in the future. The effect of this measure would be similar to removing 10 – 13 percent of the demand from the Newlands Project, depending on the efficiency of delivery to water rights holders. For simplicity in the construction of preliminary alternatives, Dixie Valley was assumed to have the same effect as reducing Project demand by 10 percent.

Preliminary Alternatives

During the planning process, alternatives often go through multiple phases iterations before reaching their final form. Many planning studies develop and evaluate alternatives with the express goal of producing and recommending one preferred alternative among several considered. In contrast to such an approach, this Study's intent is not to conclude by selecting one alternative among a range of options that have varying features and costs. This Study's goal is to formulate a range of alternatives, based on a range of Truckee Canal flow stages, that each achieve the Study objectives of safety and water supply reliability. As a result, this Study approached alternatives formulation by first developing preliminary alternatives containing all of the water supply measures that are effective or compatible with different Truckee Canal flow stages and identifying the most effective measures before the alternatives are assembled. This section of Chapter 4 describes the preliminary alternatives developed for all Truckee Canal flow stages: 600, 350, 250, 150, and 0 cfs.

As noted previously, the screening process for the water supply measures provided the basis for pairing specific measures with a range of Truckee Canal flow stages and related methods for achieving the Study's safety objective. While each preliminary alternative described below includes a list of the water supply measures considered to be compatible with a particular flow stage, not all of the measures will necessarily be included in the alternatives.

Summary of Preliminary Alternatives

Using the safety measures and water supply measures identified previously in this chapter, the Study assembled a total of 24 preliminary alternatives for the range of Truckee Canal flow stages. Figure 4-9 illustrates how measures from various subcategories were combined to reach the Desired Reliability. For each flow stage, the preliminary alternatives are presented in the same sequence and order as they are described in the following pages.

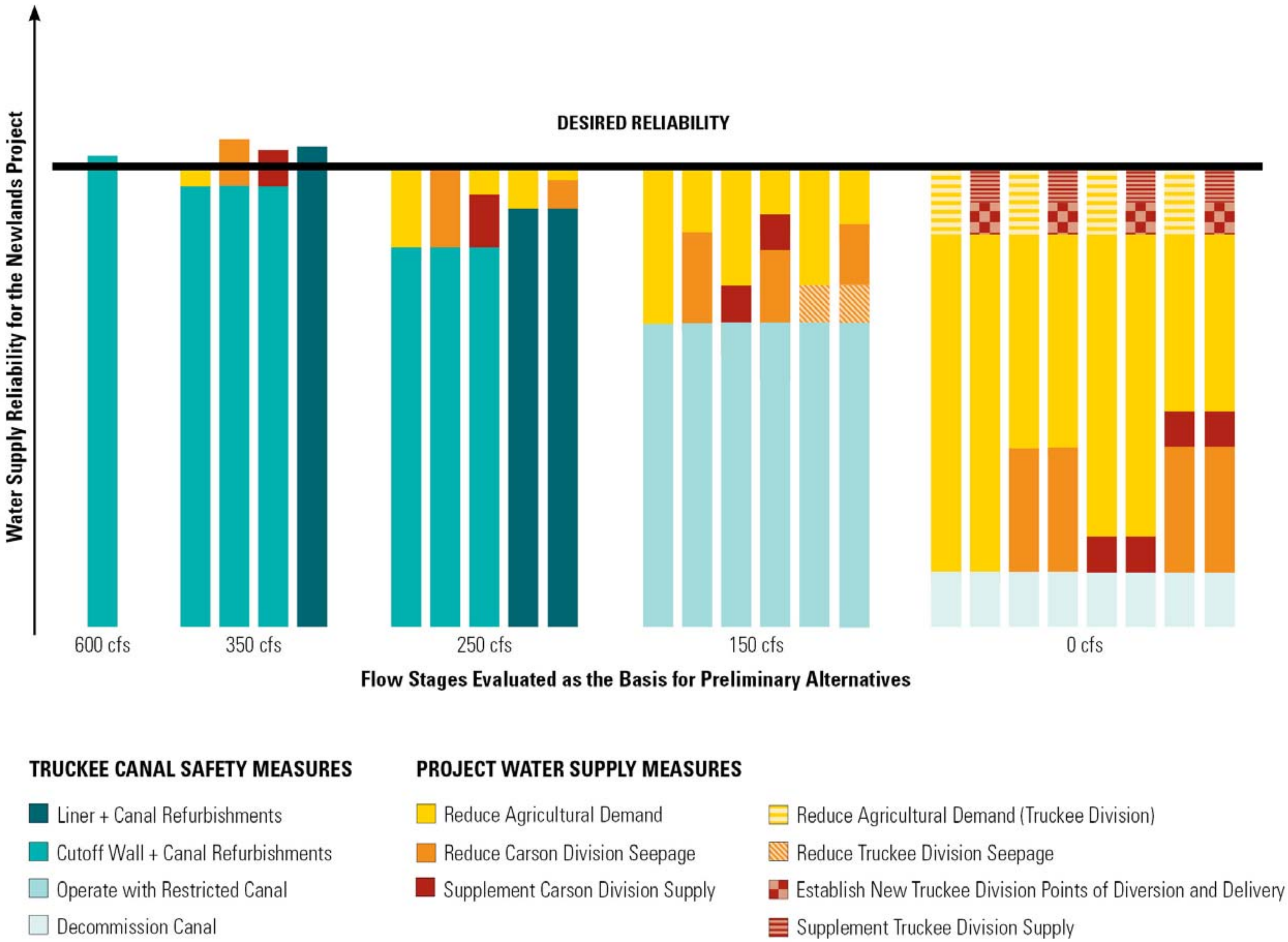


Figure 4-9. Summary of Preliminary Alternatives Assembled to Achieve Safety and Water Supply Reliability

The tables that follow (Tables 4-6 through 4-8) summarize information that is developed in greater detail later in this chapter, but also provided here for quick cross-comparison. They include the following about each preliminary alternative:

- The assumed canal capacity (flow stage)
- The measure selected for meeting the safety objective, differentiated by the options for providing structural integrity improvements along the canal (e.g., concrete lining, HDPE cutoff wall)
- The primary measure selected for meeting the water supply objective. For each preliminary alternative, this measure was applied to its maximum extent before relying on additional measures for meeting the water supply objective
- Any additional measures selected for meeting the water supply objective
- Initial estimates of the field cost for each alternative, including the potential high and low range of costs

Table 4-6 summarizes the blend of measures in each of the preliminary alternatives developed for flow stages of 600, 350, 250, and 150 cfs; it does not include preliminary alternatives for the 0 cfs flow stage. The complexity of meeting the water supply objective for the 0 cfs flow stage required that the Carson and Truckee divisions be considered separately. Table 4-7 presents components of preliminary alternatives developed for meeting the water supply objective for each division, independently, at the 0 cfs flow stage. Finally, Table 4-8 shows these components combined into preliminary alternatives that meet the water supply objective for both divisions under a 0 cfs flow-stage condition.

Table 4-6. Summary of Preliminary Alternatives between Flow Stages of 600 cfs and 150 cfs

Truckee Canal Flow Stage		Measures Selected to Meet Objectives			Est. Annual Cost ($ Million)[1,2]	
		Safety	Water Supply			
			Primary Measure	Additional Measure(s)	Low	High
600 cfs		HDPE Cutoff Wall	None		$2.10	$2.10
350 cfs	a	HDPE Cutoff Wall	Reduce Agricultural Demand *(5 to 15%, 2 measures)*	None	$2.50	$3.90
	b		Reduce Carson Division Seepage *(2 measures)*	None	$2.60	$10.00
	c		Supplement Carson Division *(1 measure)*	None	$6.50	$13.00
	d	Concrete/ Geomembrane Liner	None		$2.80	$2.80
250 cfs	a	HDPE Cutoff Wall	Reduce Agricultural Demand *(20 to 25%, 2 measures)*	None	$3.70	$5.10
	b		Reduce Carson Division Seepage *(2 measures)*	None	$2.60	$10.00
	c		Supplement Carson Division Supply *(1 measure)*	Reduce Agricultural Demand *(10 to 15%, 2 measures)*	$7.30	$15.00
	d	Concrete/ Geomembrane Liner	Reduce Agricultural Demand *(10 to 15%, 2 measures)*	None	$3.60	$5.20
	e		Reduce Carson Division Seepage *(2 measures)*	Reduce Agricultural Demand *(0 to 10%, 2 measures)*	$3.30	$5.10

Table 4-6. Summary of Preliminary Alternatives between Flow Stages of 600 cfs and 150 cfs (contd.)

Truckee Canal Flow Stage		Measures Selected to Meet Objectives				Est. Annual Cost ($ Million)[1,2]	
		Safety	Water Supply				
			Primary Measure	Additional Measure(s)		Low	High
150 cfs	a	Maintain Flows at or Below Flow Stage	Reduce Agricultural Demand *(35 to 45%, 2 measures)*	None		$2.90	$5.30
	b		Reduce Carson Division Seepage *(2 measures)*	Reduce Agricultural Demand *(15 to 25%, 2 measures)*		$1.70	$11.00
	c		Supplement Carson Division Supply *(1 measure)*	Reduce Agricultural Demand *(25 to 35%, 2 measures)*		$6.40	$15.00
	d		Reduce Carson Division Seepage *(2 measures)*	Supplement Carson Division Supply*(1 measure)*	Reduce Agricultural Demand *(0 to 25%, 2 measures)*	$4.90	$22.00
	e		Reduce Truckee Division Seepage *(1 measure)*	Reduce Agricultural Demand *(25 to 40%, 2 measures)*		$2.20	$4.90
	f		Reduce Truckee Division Seepage *(1 measure)*	Reduce Carson Division Seepage *(2 measures)*	Reduce Agricultural Demand *(15 to 30%, 2 measures)*	$1.90	$12.00

Notes:
[1] Cost estimates have been formatted to indicate the annual cost of implementing each preliminary alternative, relative to the full range of costs developed for preliminary alternatives. Green represents lower costs (lowest being $1.7 million), red represents higher costs (highest being $22 million), and yellow represents mid-range costs.
[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure). See Appendix E2 for additional information.

Key:
cfs = cubic feet per second
HDPE = High Density Polyethylene

Table 4-7. Components of 0 cfs Preliminary Alternatives by Division

Focus of Component		Measures to Meet the Water Supply Objective			Est. Annual Cost ($ Million)[1]	
		Primary Measure	Additional Measure(s)		Low	High
Carson Division	a	Reduce Agricultural Demand *(70 to 80%, 2 measures)*	None		$5.60	$10.00
Carson Division	b	Reduce Carson Division Seepage *(2 measures)*	Reduce Agricultural Demand *(60 to 70%, 2 measures)*		$5.20	$15.00
Carson Division	c	Supplement Carson Division Supply *(1 measure)*	Reduce Agricultural Demand *(60 to 70%, 2 measures)*		$9.10	$18.00
Carson Division	d	Reduce Carson Division Seepage *(2 measures)*	Supplement Carson Division Supply *(1 measure)*	Reduce Agricultural Demand *(50 to 60%, 2 measures)*	$8.80	$25.00
Truckee Division	y	Reduce Agricultural Demand *(100%, 1 measure)*	None		$1.00	$1.00
Truckee Division	z	Establish New Truckee Division Points of Diversion and Delivery *(Agriculture, 1 measure)*	Supplement Truckee Division Supply *(2 measures)*		$8.40	$11.00

Notes:
[1] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure). See Appendix E2 for additional information.
Key:
cfs = cubic feet per second

Table 4-8. Summary of Preliminary Alternatives for a Flow Stage of 0 cfs

Truckee Canal Flow Stage		Measures Selected to Meet Objectives			Est. Annual Cost ($ Million)[1,2]	
		Safety	Water Supply			
			Components Selected		Low	High
0 cfs	ay	Decommission Truckee Canal	Carson Division 0.a	Truckee Division 0.y	$6.60	$11.00
	az			Truckee Division 0.z	$14.00	$21.00
	by		Carson Division 0.b	Truckee Division 0.y	$6.20	$16.00
	bz			Truckee Division 0.z	$13.60	$26.00
	cy		Carson Division 0.c	Truckee Division 0.y	$10.10	$19.00
	cz			Truckee Division 0.z	$17.50	$29.00
	dy		Carson Division 0.d	Truckee Division 0.y	$9.80	$26.00
	dz			Truckee Division 0.z	$17.20	$36.00

Notes:

[1] Cost estimates have been formatted to indicate the annual cost of implementing each preliminary alternative, relative to the full range of costs developed for preliminary alternatives. Green represents lower costs (lowest being $6.2 million), red represents higher costs (highest being $36 million), and yellow represents mid-range costs.

[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure). See Appendix E2 for additional information.

Key:

cfs = cubic feet per second

Preliminary Alternatives for the 600 cfs Flow Stage

One preliminary alternative was developed for meeting the Study objectives with a Truckee Canal flow stage of 600 cfs. This preliminary alternative relies upon a single measure for meeting the Study's safety objective, and the flow stage alone fully satisfies the Study's water supply objective, precluding the need for additional measures.

Table 4-9 shows the estimated cost, annually, for meeting both Study objectives at the 600 cfs flow stage. The following sections provide additional detail on the water supply needs at 600 cfs, and the rationale behind selecting measures to meet Study objectives.

Approaches for Meeting the Safety Objective at 600 cfs

Corrective actions that would satisfy the Study safety objective at 600 cfs include changes to O&M and structural features of the Truckee Canal. The lowest-cost approach – which relies in part upon an HDPE cutoff wall – was selected as the initial measure for developing a preliminary alternative that, at a minimum, meets the safety objective. However, full alternatives for the 600 cfs flow stage could consider whether the additional seepage reduction benefit provided by a concrete geomembrane liner is worth the additional cost that potential cost-share partners would incur (see Appendix D2 for a discussion of canal lining at different flow stages, including 600 cfs).

Approaches for Meeting the Water Supply Objective at 600 cfs

No additional measures are required to meet the water supply objective when the allowable flow stage in the Truckee Canal is 600 cfs.

Table 4-9. Measures Selected for Preliminary Alternatives with a 600 cfs Flow Stage

Preliminary Alternative Name	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2]	
			Low	High
600.a	HDPE Cutoff Wall		$2.10	$2.10
		None	-	-
	Range of Total Costs (annual)		$2.10	$2.10

Notes:
Discrepancies may exist due to rounding (Reclamation Manual Directives and Standards FAC 09-01).
[1] Annual cost for each measure is discussed in Appendix E2.
[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure).
Key:
HDPE = High Density Polyethylene

Preliminary Alternatives for the 350 cfs Flow Stage

Four preliminary alternatives were developed for meeting the Study objectives with a Truckee Canal flow stage of 350 cfs. These preliminary alternatives rely upon one of two measures for meeting the Study's safety objective, and combinations of up to three different measures for meeting the Study's water supply objective.

The estimated annual cost for meeting both Study objectives at the 350 cfs flow stage ranges between $2.5 million and $13 million, depending on the preliminary alternative selected. The following sections provide additional detail on the water supply needs at a flow stage of 350 cfs, and the rationale behind selecting measures to meet Study objectives.

Approaches for Meeting the Safety Objective at 350 cfs

Three preliminary alternatives (350.a, b, and c) rely on the lowest-cost measure for meeting the safety objective, which includes implementation of an HDPE cutoff wall.

One of the preliminary alternatives (350.d) relies on the highest-cost measure for meeting the safety objective, which includes implementation of a concrete liner and geomembrane along portions of the Truckee Canal as described previously. This measure reduces seepage along the Truckee Canal in a manner that contributes to the water supply objective, as discussed in the following section.

Approaches for Meeting the Water Supply Objective at 350 cfs

350.a Preliminary alternative 350.a meets the water supply objective through a 5 percent to 15 percent reduction in the Project's agricultural demand. The ability to meet the water supply objective with demand reductions is described in Appendix D3.

Preliminary alternative 350.a would include one of two measures from the "Reduce Agricultural Demand" category: one to acquire and permanently retire Project water rights, and another to reduce agricultural demand in dry years, such as through volunteer fallowing programs or partial season forbearance agreements.

350.b Preliminary alternative 350.b meets the water supply objective through increases in Project efficiency. The ability to meet the water supply objective with efficiency improvements is described in Appendix D4.

Preliminary alternative 350.b would include one of two measures from the "Reduce Carson Division Seepage" subcategory: lining or compacting the soil lining of the division's main conveyance features. Both have the potential to produce increases in Project efficiency that will meet the water supply objective. The range of estimated costs for these measures reflects unknowns in the extent of potential canal rehabilitation needed and differences in price between the two approaches. If implemented, either of these may also reduce maintenance costs to TCID.

350.c Preliminary alternative 350.c meets the water supply objective through importing groundwater from Dixie Valley. The assessed yield of Dixie Valley (35,000 acre-feet per year) meets or exceeds the volume of water supply needs for the 350 cfs flow stage, as shown in Figure 4-4.

350.d Preliminary alternative 350.d meets most of the water supply objective through implementation of the safety measure that includes a concrete and geomembrane lining. This is assessed in Appendix D2.

Table 4-10 includes the estimated annual costs for the 350 cfs preliminary alternatives.

Table 4-10. Measures Selected for Preliminary Alternatives with a 350 cfs Flow Stage

Preliminary Alternative Name	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2] Low	High
350.a	HDPE Cutoff Wall		$2.10	$2.10
		Reduce Agricultural Demand (5 to 15%)		
		Fallowing/Partial Season Agreements	$0.39	$1.80
		Acquire and Retire Water Rights	$0.45	$1.35
	Range of Total Costs (annual)		**$2.50**	**$3.90**
350.b	HDPE Cutoff Wall		$2.10	$2.10
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
	Range of Total Costs (annual)		**$2.60**	**$10.00**
350.c	HDPE Cutoff Wall		$2.10	$2.10
		Supplement Carson Division Supply		
		Import Dixie Valley Groundwater	$4.40	$11.00
	Range of Total Costs (annual)		**$6.50**	**$13.00**
350.d	Concrete/ Geomembrane Lining		$2.80	$2.80
		None		
	Range of Total Costs (annual)		**$2.80**	**$2.80**

Notes:
Discrepancies may exist due to rounding (Reclamation Manual Directives and Standards FAC 09-01).
[1] Annual cost for each measure is discussed in Appendix E2.
[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure).
Key:
cfs = cubic feet per second
HDPE = High Density Polyethylene

Preliminary Alternatives for the 250 cfs Flow Stage

Five preliminary alternatives were developed for meeting the Study objectives with a Truckee Canal flow stage of 250 cfs. These preliminary alternatives rely upon two measures for meeting the Study's safety objective, and a number of combinations of measures for meeting the Study's water supply objective.

The estimated annual cost for meeting both Study objectives at the 250 cfs flow stage is between $2.6 million and $15 million, depending on the preliminary alternative selected. The following sections provide additional detail on the water supply needs at a flow stage of 250 cfs, and the rationale behind selecting measures to meet Study objectives.

Approaches for Meeting the Safety Objective at 250 cfs

Three preliminary alternatives (250.a, b, and c) rely on the lowest-cost measure for meeting the safety objective, which includes implementation of an HDPE cutoff wall.

Two of the preliminary alternatives (250.d and 250.e) rely upon the highest-cost measure for meeting the safety objective, which includes implementation of a concrete liner and geomembrane along portions of the Truckee Canal, as described previously. This measure reduces seepage along the Truckee Canal, which also contributes to the water supply objective, but does not fully meet it.

Approaches for Meeting the Water Supply Objective at 250 cfs

250.a Preliminary alternative 250.a meets the water supply objective through reductions in the Project's agricultural demand. The ability to meet the water supply objective with demand reductions is described in Appendix D3.

Preliminary alternative 250.a would include one of two measures from the "Reduce Agricultural Demand" category: one to acquire and permanently retire Project water rights, and another to reduce agricultural demand in dry years, such as through volunteer fallowing programs or partial season forbearance agreements. These measures would aim to reduce Project agricultural demand by 20 percent to 25 percent.

250.b Preliminary alternative 250.b meets the water supply objective through increases in Project efficiency. The ability to meet the water supply objective with efficiency improvements is described in Appendix D4.

As with preliminary alternative 350.b, 250.b would include one of two measures from the "Reduce Carson Division Seepage" subcategory: lining or compacting the soil lining of the division's main conveyance features. Both have the potential to produce increases in Project efficiency that will meet the water supply objective. The range of estimated costs for these measures reflects unknowns in the extent of potential canal rehabilitation needed and differences in price between the two approaches. If implemented, either of these may also reduce maintenance costs to TCID.

250.c Preliminary alternative 250.c meets the water supply objective through the importation of Dixie Valley groundwater and reductions in Project agricultural demand. The ability to meet the water supply objective by reducing demand is described in Appendix D3.

The assessed yield of Dixie Valley (35,000 acre-feet per year) meets a significant portion of the water supply needs under the 250 cfs flow stage. However, meeting the water supply objective requires obtaining more than this volume for a large number of years.

To address the unmet demand that is not fully eliminated by Dixie Valley supplies, preliminary alternative 250.c would also include at least one of two measures from the “Reduce Agricultural Demand” category. These measures would aim to reduce demand by 10 to 15 percent.

250.d Preliminary alternative 250.d meets some of the water supply objective through implementation of the safety measure that includes a concrete and geomembrane lining. This is assessed in Appendix D2.

Additionally, to address the unmet demand still remaining, 250.d would also include at least one of two measures from the “Reduce Agricultural Demand” category. These measures would aim to reduce demand by 10 to 20 percent.

250.e As with 250.d, preliminary alternative 250.e meets some of the water supply objective through implementation of the safety measure that includes a concrete and geomembrane lining. This is assessed in Appendix D2.

As with preliminary alternative 250.b, 250.e would include one of two measures from the “Reduce Carson Division Seepage” subcategory: lining or compacting the soil lining of the division’s main conveyance features.

Additionally, to address the unmet demand still remaining, 250.e would include at least one of two measures from the “Reduce Agricultural Demand” category. These measures would aim to reduce demand by up to 10 percent.

Table 4-11 includes the estimated annual costs for the 250 cfs preliminary alternatives.

Table 4-11. Measures Selected for Preliminary Alternatives with a 250 cfs Flow Stage

Preliminary Alternative Name	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2]	
			Low	High
250.a	HDPE Cutoff Wall		$2.10	$2.10
		Reduce Agricultural Demand (20 to 25%)		
		Fallowing/Partial Season Agreements	$1.60	$3.00
		Acquire and Retire Water Rights	$1.80	$2.20
	Range of Total Costs (annual)		**$3.70**	**$5.10**
250.b	HDPE Cutoff Wall		$2.10	$2.10
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
	Range of Total Costs (annual)		**$2.60**	**$10.00**
250.c	HDPE Cutoff Wall		$2.10	$2.10
		Supplement Carson Division Supply		
		Import Dixie Valley Groundwater	$4.40	$11.00
		Reduce Agricultural Demand (10 to 15%)		
		Fallowing/Partial Season Agreements	$0.79	$1.80
		Acquire and Retire Water Rights	$0.90	$1.35
	Range of Total Costs (annual)		**$7.30**	**$15.00**
250.d	Concrete/ Geomembrane Lining		$2.80	$2.80
		Reduce Agricultural Demand (10 to 20%)		
		Fallowing/Partial Season Agreements	$0.79	$2.40
		Acquire and Retire Water Rights	$0.90	$1.80
	Range of Total Costs (annual)		**$3.60**	**$5.20**

Table 4-11. Measures Selected for Preliminary Alternatives with a 250 cfs Flow Stage (contd.)

Preliminary Alternative Name	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2] Low	Estimated Costs ($ Million, annual)[1,2] High
250.e	Concrete/ Geomembrane Lining		$2.80	$2.80
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
		Reduce Agricultural Demand (0 to 10%)		
		Fallowing/Partial Season Agreements	$0.00	$1.20
		Acquire and Retire Water Rights	$0.00	$0.90
	Range of Total Costs (annual)		**$3.30**	**$5.10**

Notes:
Discrepancies may exist due to rounding (Reclamation Manual Directives and Standards FAC 09-01).
[1] Annual cost for each measure is discussed in Appendix E2.
[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure).
Key:
cfs = cubic feet per second
HDPE = High Density Polyethylene

Preliminary Alternatives for the 150 cfs Flow Stage

Six preliminary alternatives were developed for meeting the Study objectives with a Truckee Canal flow stage of 150 cfs. These preliminary alternatives build upon the assumed future condition of the Truckee Canal, where capacity has been restricted to flow stages that do not exceed 150 cfs.

The estimated annual cost for meeting both Study objectives at the 150 cfs flow stage is between $1.7 million and $22 million, depending on the preliminary alternative selected. The following sections provide additional detail on the water supply needs at a flow stage of 150 cfs, and the rationale behind selecting measures to meet Study objectives.

Approaches for Meeting the Safety Objective at 150 cfs

Reclamation considers a flow stage of 150 cfs in the Truckee Canal, in combination with other revisions to O&M and ongoing structural repair projects, to meet the safety objective of the Study. As described in Chapter 3, the 150 cfs flow stage is considered to be the likely future condition for the Truckee Canal, absent more comprehensive structural repairs.

Approaches for Meeting the Water Supply Objective at 150 cfs

150.a Preliminary alternative 150.a meets the water supply objective through 35 percent to 45 percent reduction in the Project's agricultural demand. The ability to meet the water supply objective with demand reductions is described in Appendix D3.

Preliminary alternative 150.a would include one of two measures from the "Reduce Agricultural Demand" category: one to acquire and permanently retire Project water rights, and another to reduce agricultural demand in dry years, such as through volunteer fallowing programs or partial season forbearance agreements. As the implementation of dry-year demand reduction programs are likely limited to no more than 30 percent of the Project, at least 5 percent of the water rights would need to be permanently retired.

150.b Preliminary alternative 150.b meets the water supply objective through increases in Project efficiency and reductions in Project agricultural demand.

As with preliminary alternative 250.b, 150.b would include one of two measures from the "Reduce Carson Division Seepage" subcategory: lining or compacting the soil lining of the division's main conveyance features. Both have the potential to produce increases in Project efficiency that will make large contributions to meeting the water supply objective. The range of estimated costs for these measures reflects unknowns in the extent of potential canal rehabilitation needed and differences in price between the two approaches. If implemented, either of these may also reduce maintenance costs to TCID.

Preliminary alternative 150.b would also include one of two measures from the "Reduce Agricultural Demand" category: one to acquire and permanently retire Project water rights, and another to reduce agricultural demand in dry years, such as through volunteer fallowing programs or partial season forbearance agreements. These measures would aim to reduce Project agricultural demand by 15 percent to 25 percent. Both measures contribute equally to the Study's water supply objective.

150.c Preliminary alternative 150.c meets the water supply objective through the importation of Dixie Valley groundwater and reductions in Project agricultural demand.

The assessed yield of Dixie Valley (35,000 acre-feet per year) meets a significant portion of the water supply needs under the 150 cfs flow stage. However, meeting the water supply objective requires obtaining more than this volume for a large number of years.

To address the unmet demand that is not fully eliminated by Dixie Valley supplies, preliminary alternative 150.c would also include at least one of two measures from the "Reduce Agricultural Demand" category. These measures would aim to reduce Project agricultural demand by 25 percent to 35 percent.

As the implementation of dry-year demand reduction programs are likely limited to no more than 30 percent of the Project, up to 5 percent of the water rights may need to be permanently retired.

150.d Preliminary alternative 150.d meets the water supply objective through implementation of three actions: (1) increases in Project efficiency, (2) importation of Dixie Valley groundwater, and (3) reductions in Project agricultural demand. The ability to meet the water supply objective with demand reductions and efficiency improvements is described in Appendix D3 and Appendix D4, respectively.

Preliminary alternative 150.d would include one of two measures from the “Reduce Carson Division Seepage” subcategory: lining or compacting the soil lining of the division’s main conveyance features. Both have the potential to produce increases in Project efficiency that will make large contributions to meeting the water supply objective. The range of estimated costs for these measures reflects unknowns in the extent of potential canal rehabilitation needed and differences in price between the two approaches. If implemented, either of these may also reduce maintenance costs to TCID.

The assessed yield of Dixie Valley (35,000 acre-feet per year) meets a significant portion of the water supply needs under the 150 cfs flow stage. However, meeting the water supply objective requires obtaining more than this volume for a large number of years.To address the unmet demand that is not fully eliminated by Dixie Valley supplies and increased efficiency, preliminary alternative 150.d would also include at least one of two measures from the “Reduce Agricultural Demand” category. These measures would aim to reduce Project agricultural demand by up to 25 percent.

150.e Preliminary alternative 150.e meets the water supply objective through implementation of two actions: (1) reduction of seepage losses from the Truckee Canal and (2) reductions in Project agricultural demand. The ability to meet the water supply objective through seepage reductions on the Truckee Canal and through reductions in demand is described in Appendix D2 and Appendix D3, respectively.

Preliminary alternative 150.e relies on compaction of the earthen embankment along the Truckee Canal to reduce seepage losses.

Preliminary alternative 150.e would include at least one of two measures from the “Reduce Agricultural Demand” category. These measures would aim to reduce Project agricultural demand by 25 percent to 40 percent. As the implementation of dry-year demand reduction programs are likely limited to no more than 30 percent of the Project, up to 10 percent of the water rights may need to be permanently retired.

150.f Preliminary alternative 150.f meets the water supply objective through implementation of three actions: (1) reduction of seepage losses from the Truckee Canal (Appendix D2), (2) increases in Project efficiency (Appendix D4), and (3) reduction in Project agricultural demand (Appendix D3).

Preliminary alternative 150.f relies on compaction of the earthen embankment along the Truckee Canal to reduce seepage losses. .

Preliminary alternative 150.f would also include one of two measures from the "Reduce Carson Division Seepage" subcategory: lining or compacting the soil lining of the division's main conveyance features.

Additionally, to address the unmet demand still remaining, preliminary alternative 150.f would include at least one of two measures from the "Reduce Agricultural Demand" category. These measures would aim to reduce Project agricultural demand by 15 percent to 30 percent. Table 4-12 includes the estimated annual costs for the 150 cfs preliminary alternatives.

Table 4-12. Measures Selected for Preliminary Alternatives with a 150 cfs Flow Stage

Preliminary Alternative Name	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2] Low	Estimated Costs ($ Million, annual)[1,2] High
150.a	Operate at 150 cfs		$0.02	$0.02
		Reduce Agricultural Demand (35 to 45%)		
		Fallowing/Partial Season Agreements (up to 30%)	$2.90	$5.30
		Acquire and Retire Water Rights (up to 45%)		
	Range of Total Costs (annual)		**$2.90**	**$5.30**
150.b	Operate at 150 cfs		$0.02	$0.02
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
		Reduce Agricultural Demand (15 to 25%)		
		Fallowing/Partial Season Agreements	$1.20	$3.00
		Acquire and Retire Water Rights	$1.35	$2.20
	Range of Total Costs (annual)		**$1.70**	**$11.00**
150.c	Operate at 150 cfs		$0.02	$0.02
		Supplement Carson Division Supply		
		Import Dixie Valley Groundwater	$4.40	$11.00
		Reduce Agricultural Demand (25 to 35%)		
		Fallowing/Partial Season Agreements (up to 30%)	$1.95	$4.10
		Acquire and Retire Water Rights (up to 35%)		
	Range of Total Costs (annual)		**$6.40**	**$15.00**
150.d	Operate at 150 cfs		$0.02	$0.02
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
		Supplement Carson Division Supply		
		Import Dixie Valley Groundwater	$4.40	$11.00
		Reduce Agricultural Demand (0 to 25%)		
		Fallowing/Partial Season Agreements	$0.00	$3.00
		Acquire and Retire Water Rights	$0.00	$2.20
	Range of Total Costs (annual)		**$4.90**	**$22.00**

Table 4-12. Measures Selected for Preliminary Alternatives with a 150 cfs Flow Stage (contd.)

Preliminary Alternative Name	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2] Low	High
150.e	Operate at 150 cfs		$0.02	$0.02
		Reduce Truckee Division Seepage		
		Compact the Soil Lining of the Truckee Canal	$0.19	$0.37
		Reduce Agricultural Demand (25 to 40%)		
		Fallowing/Partial Season Agreements (up to 30%)	$1.95	$4.50
		Acquire and Retire Water Rights (up to 40%)		
	Range of Total Costs (annual)		**$2.20**	**$4.90**
150.f	Operate at 150 cfs		$0.02	$0.02
		Reduce Truckee Division Seepage		
		Compact the Soil Lining of the Truckee Canal	$0.19	$0.37
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
		Reduce Agricultural Demand (15 to 30%)		
		Fallowing/Partial Season Agreements	$1.20	$3.60
		Acquire and Retire Water Rights	$1.35	$2.70
	Range of Total Costs (annual)		**$1.90**	**$12.00**

Notes:
Discrepancies may exist due to rounding (Reclamation Manual Directives and Standards FAC 09-01).
[1] Annual cost for each measure is discussed in Appendix E2.
[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure).
Key:
cfs = cubic feet per second
HDPE = High Density Polyethylene

Preliminary Alternatives for the 0 cfs Flow Stage

Six preliminary alternatives were developed for meeting the Study objectives with a Truckee Canal flow stage of 0 cfs. The following discussion of preliminary alternatives for the 0 cfs flow stage is organized differently than in previous sections. The 0 cfs condition for the Truckee Canal creates distinctly different challenges for the Truckee and Carson divisions, and the approaches for resolving these challenges were found to be unrelated—without the Truckee Canal to connect the Project’s two divisions, each division’s source of supply is independent. Therefore, separate approaches were developed for meeting the water supply objective in each division.

To be considered complete, all preliminary alternatives must contain an approach for meeting the water supply objective for both divisions. Four approaches were developed for the Carson Division: Carson Division 0.a, 0.b, 0.c, and 0.d. Two approaches were developed for the Truckee Division: Truckee Division 0.y and 0.z. Thus, the number of preliminary alternatives includes a total of eight combinations of the approaches for the Carson and Truckee divisions.

The estimated annual cost for meeting both Study objectives at the 0 cfs flow stage ranges from $6.2 million to $36 million, depending on the measures selected. Although the group of 0 cfs Truckee Canal preliminary alternatives is the most expensive group of all preliminary alternatives developed, some Project stakeholders, such as the Pyramid Lake Paiute Tribe, have a longstanding interest in exploring whether it is possible to decommission the structure while still keeping the Project viable into the future. If a 0 cfs preliminary alternative were to be studied further by the tribe or another entity, it would be important to estimate the value of water that would remain in the Truckee River instead of being diverted into the Truckee Canal. Based on recent Truckee Division water right purchases by the Pyramid Lake Paiute Tribe ($4,000 - $6,000 per acre-foot), the market value of non-diverted water under a 0 cfs condition is estimated to range between $280 million and $420 million. Using the Federal discount rate over a 50-year period, the annual benefit is estimated at between $13.03 million and $19.55 million. Appendix D8, “Market Value of Non-diverted Water Under a 0 cfs Truckee Canal,” describes the approach developed for arriving at this estimate.

The following sections provide additional detail on the water supply needs at a flow stage of 0 cfs, and the rationale behind selecting measures to meet Study objectives.

Approaches for Meeting the Safety Objective at 0 cfs

Decommissioning all or most of the Truckee Canal, in combination with select structural repairs and ongoing O&M, will meet the Study’s safety objective. For half of the preliminary alternatives, the entire Truckee Canal is considered fully decommissioned; the remaining preliminary alternatives decommission the Fernley and Lahontan reaches only.

As the Fernley Reach is the urbanized portion of the Truckee Canal, it represents the highest risk to public safety from operating the canal. A measure to refurbish the Derby Reach and provide surface water to the Truckee Division through the TC-1 takeout was preserved for consideration in the approaches to meeting the water supply objective for the Truckee Division. The cost of refurbishing the TC-1 takeout were taken from the Corrective Action Study’s specifications for the Derby Reach under the 250 cfs condition. Implementation of this measure is expected to result in a cost-savings, as the repairs required to bring the Derby Reach up to Reclamation standards for 250 cfs are less expensive than having the reach decommissioned.

Approaches for Meeting the Water Supply Objective in the Carson Division at 0 cfs

Carson Division 0.a The approach for Carson Division 0.a meets the water supply objective through a reduction in Project demand of 70 percent to 80 percent. The ability to meet the water supply objective with demand reductions is described in Appendix D3. Carson Division 0.a relies upon two measures in the “Reduce Agricultural Demand” category, alone or in combination. Up to 30 percent of the demand reduction could occur through implementation of dry-year demand reduction programs, such as volunteer fallowing programs or partial forbearance agreements. The remaining 40 percent to 50 percent of agricultural demand reduction needed could occur through the acquisition and retirement of water rights in the Carson Division.

Carson Division 0.b The approach for Carson Division 0.b meets the water supply objective through increases in Project efficiency and through a reduction in Project demand of 60 percent to 70 percent.

Carson Division 0.b would include one of two measures from the “Reduce Carson Division Seepage” subcategory: lining or compacting the soil lining of the division’s main conveyance features. Both have the potential to produce increases in Project efficiency that will contribute to meeting the water supply objective (see Appendix D4). The range of estimated costs for these measures reflects unknowns in the extent of potential canal rehabilitation needed and differences in price between the two approaches. If implemented, either of these may also reduce maintenance costs to TCID.

As with Carson Division 0.a, to address remaining unmet demand, Carson Division 0.b includes two measures in the “Reduce Agricultural Demand” category, alone or in combination. Up to 30 percent of the demand reduction could occur through implementation of dry-year demand reduction programs. The remaining 30 percent to 40 percent of agricultural demand reduction needed could occur through the acquisition and retirement of water rights in the Carson Division.

Carson Division 0.c The approach for Carson Division 0.c meets the water supply objective through the importation of Dixie Valley groundwater and through a reduction in Project demand of 60 percent to 70 percent.

The assessed yield of Dixie Valley (35,000 acre-feet per year) meets a portion of the Carson Division’s water supply needs under the 0 cfs flow stage. However, meeting the water supply objective requires obtaining more than this volume for a large number of years.

As with Carson Division 0.a and Carson Division 0.b, to address remaining unmet demand, Carson Division 0.c includes two measures in the “Reduce Agricultural Demand” category, alone or in combination. Up to 30 percent of the demand reduction could occur through implementation of dry-year demand reduction programs. The remaining 30 percent to 40 percent of agricultural demand reduction needed could occur through the acquisition and retirement of water rights in the Carson Division.

Carson Division 0.d The approach for Carson Division 0.d meets the water supply objective through three measures: (1) increases in Project efficiency, (2) importation of Dixie Valley groundwater, and (3) a reduction in Project demand of 50 percent to 60 percent.

One of two measures from the “Reduce Carson Division Seepage” subcategory would be selected for Carson Division 0.d: lining or compacting the soil lining of the division’s main conveyance features. Both have the potential to produce increases in Project efficiency that will contribute to meeting the water supply objective (see Appendix D4).

The assessed yield of Dixie Valley (35,000 acre-feet per year) meets a portion of the Carson Division’s water supply needs under the 0 cfs flow stage. However, meeting the water supply objective requires obtaining more than this volume for a large number of years. To address remaining unmet demand, Carson Division 0.d includes two measures in the “Reduce Agricultural Demand” category, alone or in combination. Up to 30 percent of the demand reduction could occur through implementation of dry-year demand reduction programs. The remaining 20 percent to 30 percent of agricultural demand reduction needed could occur through the acquisition and retirement of water rights in the Carson Division.

Table 4-13 includes the estimated annual costs for the Carson Division-specific components of the 0 cfs flow stage preliminary alternatives.

Table 4-13. Components of Preliminary Alternatives with a 0 cfs Flow Stage for the Carson Division

Component of 0 cfs Preliminary Alternative	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2] Low	High
Carson Division 0.a	Decommission the Truckee Canal		*See Truckee Component*	
		Reduce Agricultural Demand (70 to 80%)		
		Fallowing/Partial Season Agreements (up to 30%)	$5.60	$10.00
		Acquire and Retire Water Rights (up to 80%)		
	Range of Total Costs (annual)		**$5.60**	**$10.00**
Carson Division 0.b	Decommission the Truckee Canal		*See Truckee Component*	
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
		Reduce Agricultural Demand (60 to 70)		
		Fallowing/Partial Season Agreements (up to 30%)	$4.70	$6.80
		Acquire and Retire Water Rights (up to 70%)		
	Range of Total Costs (annual)		**$5.20**	**$15.00**
Carson Division 0.c	Decommission the Truckee Canal		*See Truckee Component*	
		Supplement Carson Division Supply		
		Import Dixie Valley Groundwater	$4.40	$11.00
		Reduce Agricultural Demand (60 to 70%)		
		Fallowing/Partial Season Agreements (up to 30%)	$4.70	$6.80
		Acquire and Retire Water Rights (up to 70%)		
	Range of Total Costs (annual)		**$9.10**	**$18.00**

Table 4-13. Components of Preliminary Alternatives with a 0 cfs Flow Stage for the Carson Division (contd.)

Component of 0 cfs Preliminary Alternative	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2]	
			Low	**High**
Carson Division 0.d	Decommission the Truckee Canal		*See Truckee Component*	
		Reduce Carson Division Seepage (Increase Efficiency up to 75%)		
		Compact the Soil Lining of Main Canals and Laterals	$0.49	$1.05
		Line Main Canals and Laterals	$8.00	$8.00
		Supplement Carson Division Supply		
		Import Dixie Valley Groundwater	$4.40	$11.00
		Reduce Agricultural Demand (50 to 60%)		
		Fallowing/Partial Season Agreements (up to 30%)	$3.90	$5.90
		Acquire and Retire Water Rights (up to 60%)		
	Range of Total Costs (annual)		**$8.80**	**$25.00**

Notes:
Discrepancies may exist due to rounding (Reclamation Manual Directives and Standards FAC 09-01).
[1] Annual cost for each measure is discussed in Appendix E2.
[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure).
Key:
cfs = cubic feet per second
HDPE = High Density Polyethylene

Approaches for Meeting the Water Supply Objective in the Truckee Division at 0 cfs

The Truckee Division relies entirely upon the Truckee Canal for its water supplies, and thus the decommissioning of the Truckee Canal poses a singular challenge for its water rights holders: a complete replacement of the supply, the conveyance for importing supplies, or both.

This Study did not identify alternative sources capable of completely removing the Truckee Division's dependence on Truckee River water rights. An additional source for agricultural use could be developed through the treatment and reuse of City of Fernley wastewater. However, this does not fully meet agricultural demand in the division. Therefore, the measures available to the Truckee Division rely significantly on developing alternative conveyance mechanisms for existing water rights on the Truckee River.

Truckee Division 0.y The approach for Truckee Division 0.y meets the water supply objective through one measure retires agricultural demand in the Truckee Division.

From the "Reduce Agricultural Demand" category, Truckee Division 0.y relies upon the acquisition and retirement of 100 percent of all rights in the Truckee Division that are not held by the City of Fernley for M&I use.

Truckee Division 0.z The approach for Truckee Division 0.z meets the water supply objective through measures to develop a conveyance to supply agricultural water rights holders with reliable supplies, and the potential replacement of some portion of Truckee Canal supplies.

Truckee Division 0.z relies on the development of a conveyance structure for supplying water to the agricultural water rights holders along the Truckee Canal. A single measure was identified for this: construction of a pressurized steel pipeline along the existing right-of-way corridor for the Truckee Canal, with stems for delivering water at each of the current canal take-out locations.

Truckee Division 0.z would include at least one of two sources for replacing the Truckee Canal supply to serve Truckee Division agricultural water rights. Sufficient capacity would exist at either of the available supplemental points of delivery described above to provide Truckee River water to the agricultural users. However, a second option exists to supply the agricultural users with reclaimed wastewater from the City of Fernley. This option requires less water to be diverted from the Truckee River, which could result in cost savings for the sizing of diversion or delivery facilities.

The City of Fernley currently treats its wastewater to a secondary level, which would be appropriate for application to alfalfa, but not livestock. Conveyance of secondary treated water would require a more chemically resilient conveyance, at a higher cost, but would require no additional cost for the treatment of existing wastewater. Alternately, the City of Fernley wastewater could be treated to an advanced standard that would be acceptable for application to crops and livestock. This would require additional treatment and upgrade of the current wastewater facilities; however, a less expensive material would be allowed for the pipeline conveyance.

Table 4-14 includes the estimated annual costs for the Truckee Division-specific components of the 0 cfs flow-stage alternatives.

Table 4-14. Truckee Division Components for Preliminary Alternatives with a 0 cfs Flow Stage

Component of 0 cfs Preliminary Alternative	Measure Selected for Safety Objective	Measures Available for Water Supply Objective	Estimated Costs ($ Million, annual)[1,2]	
			Low	**High**
Truckee Division 0.y	Decommission the Truckee Canal		$0.52	$0.52
		Reduce Agricultural Demand (100% for Truckee Division Agriculture)		
		Acquire and Retire Water Rights	$0.48	$0.48
	Range of Total Costs (annual)		**$1.00**	**$1.00**
			Low	**High**
Truckee Division 0.z	Decommission the Truckee Canal		$0.52	$0.52
		Establish New Truckee Division Points of Diversion and Delivery (Agriculture)		
		Construct Pipeline to Agricultural Users	$7.90	$8.60
		Supplement Truckee Division Supply (for Truckee Division Agriculture)		
		Use City of Fernley Point of Diversion	$0.00	$0.00
		Treat Effluent and Deliver for Agricultural Use	$0.00	$1.85
	Range of Total Costs (annual)		**$8.40**	**$11.00**

Notes:
Discrepancies may exist due to rounding (Reclamation Manual Directives and Standards FAC 09-01).
[1] Annual cost for each measure is discussed in Appendix E2.
[2] Annual costs include interest and amortization of the field cost based on the current Federal discount rate of 4 percent, over an assumed service life of the measures included (from 5 to 65 years depending on the specific measure).
Key:
cfs = cubic feet per second
HDPE = High Density Polyethylene

Selection of Study Alternatives

Figure 4-10 describes attributes of the preliminary alternatives developed for the Study: estimated range of annualized costs, complexity (defined by number of measures required to meet both objectives), the extent of temporary or permanent demand reduction required (a concern of all water rights holders in the Project), the annual hydropower production by the Project (a key component of financial revenues for TCID), the annual seepage losses from Truckee Canal (a concern of the City of Fernley, Truckee Division water users, and the Pyramid Lake Paiute Tribe), and the average annual flow to Pyramid Lake (a concern of the Pyramid Lake Paiute Tribe). The values in this figure are not precise, and reflect estimated outcomes for each preliminary alternative. These parameters represent the readily quantifiable attributes of each preliminary alternative, as developed during the measures screening and overall planning process.

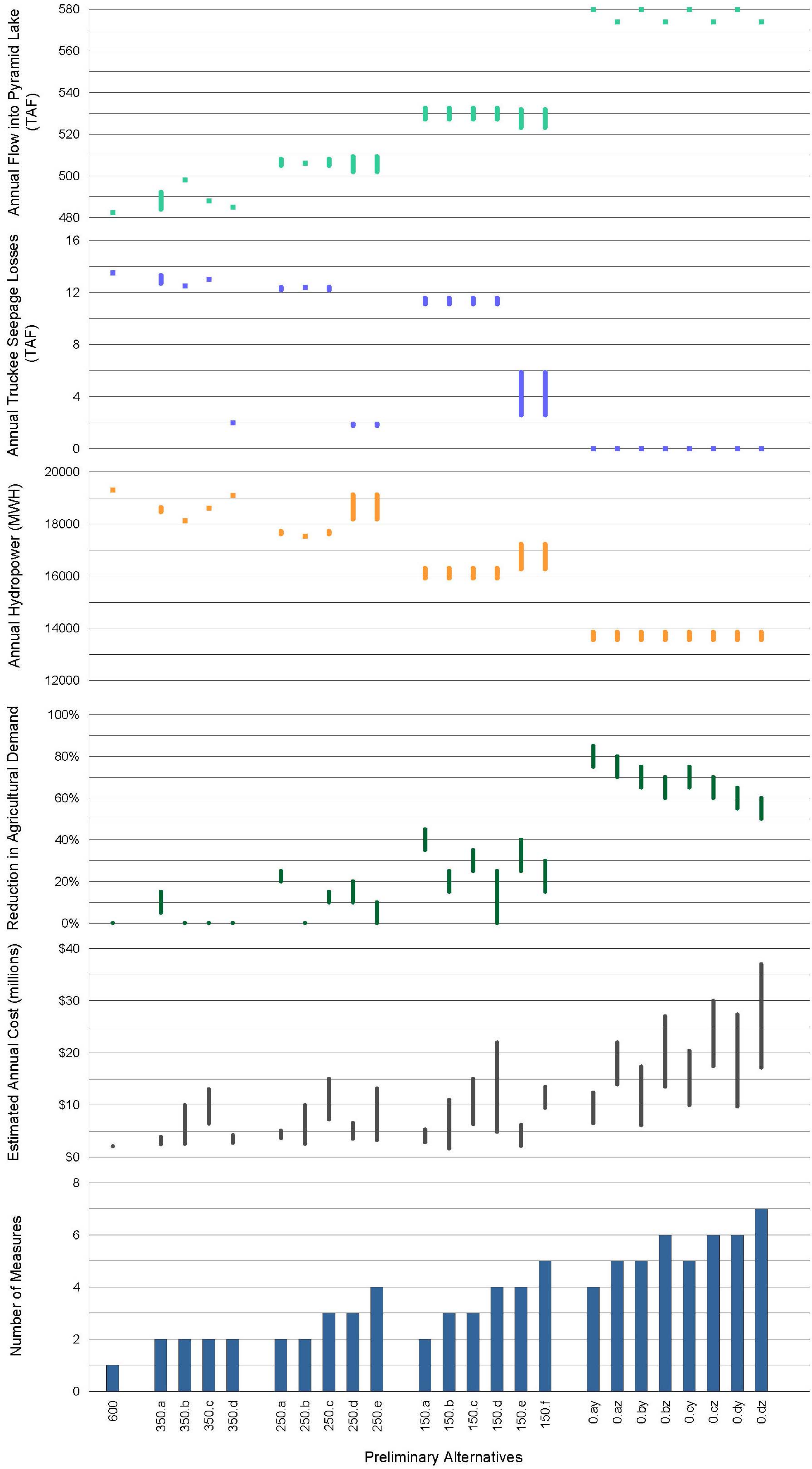


Figure 4-10. Key Attributes of Preliminary Alternatives

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Agency Review of Preliminary Alternatives and Planning Criteria

Once preliminary alternatives were developed, the Study team sought the review of agencies and tribes, which presented opportunities for agencies to:

- Understand how measures identified for consideration in the Study have been characterized and analyzed, and suggest revisions to the characterizations of particular measures used in preliminary alternatives.
- Contribute to the descriptions of the preliminary alternatives and identify the potential for benefits or negative impacts associated with each.
- Identify or clarify how planning criteria could be used in selecting and refining Study alternatives.
- Provide feedback on priorities for remaining analyses in the Study.

The Study team reviewed the preliminary alternatives and draft Special Report with representatives from TCID, the City of Fernley, Churchill County, the Pyramid Lake Paiute Tribe, and USFWS. The comments received assisted the Study team in applying the planning criteria to select alternatives for further evaluation. Comments received during this review appear in Appendix H, “Public Participation and Outreach.”

Inclusion of agencies in the review and assessment of the preliminary alternatives also promotes the Study’s intent, which is the development of plans for meeting Study objectives that, ultimately, may be implemented by local, regional, State, and/or Federal partners.

Application of Planning Criteria

Following the agency review of preliminary alternatives and planning criteria, the planning criteria could be further applied to screen the preliminary alternatives. The purpose of this screening of preliminary alternatives is to reduce the number of options available for consideration before proceeding with more detailed evaluation of alternatives. This step further leverages the criteria that have been used in the identification of preliminary alternatives that are the most suitable for a more rigorous analysis. The following section discusses how the preliminary alternatives were viewed under each of the P&G criteria. The discussion in this section relies heavily upon comparisons between alternatives made with information shown in Figure 4-10.

Completeness

Completeness is a determination of whether an alternative includes all of the elements necessary to realize its planned effects, and to the degree that the intended benefits depend on other actions.

With respect to completeness, all preliminary alternatives contain the basic actions necessary to achieve their intent to meet the Study objectives. However, uncertainty exists surrounding certain measures or features of some alternatives in particular. These are noted in the subsections below.

150 cfs Flow Stage

The 150 cfs preliminary alternatives may not be complete for a variety of reasons, including:

- Safety is not necessarily assured, and would require further Reclamation review to approve of continued operation.

Fernley has unpublished results indicating that Truckee Canal seepage may be insufficient for meeting local groundwater availability needs, and further measures may be required to meet these needs at a 150 cfs flow stage (City of Fernley 2012).All 150 cfs preliminary alternatives rely upon the reduced flow-stage to satisfy the safety objective.

Compaction

Compaction may not work effectively to reduce seepage from the Project's canals and laterals. Comments from TCID during the agency's review of preliminary alternatives suggest that the technique, which has delivered highly desirable results in California, may not work in Nevada for a variety of reasons (Walter Winder, TCID, personal communication, October 4, 2012). This includes different conditions than are present in Nevada, different soil geology, and the freeze-thaw cycles which could "un-compact" canal soils each winter. This would require that all 300-plus miles of canals and laterals be re-compacted annually immediately after the thaw, which may not be practical and would increase costs. Preliminary alternatives that rely upon compaction include 150.e and 150.f. Up to nine other preliminary alternatives also have the option to include compaction of canals and laterals to reduce losses due to seepage, but do not need to rely on this method.

Availability of Willing Participants for Demand Reduction Programs

In reviewing the preliminary alternatives with agencies and tribes, several raised concerns that the high level of temporary or permanent agricultural land retirement anticipated for some of the preliminary alternatives, particularly those for 150 cfs and 0 cfs, may not be realistic:

- Willing sellers are not plentiful: there has been a decreasing level of interest in participating in existing water rights purchasing programs, such as USFWS's acquisition program for Lahontan Valley wetlands.

- The new dry milk processing facility planned for construction in Fallon is expected to encourage the preservation of agricultural land uses in the Project and could increase the value of those rights (Churchill County 2012; TCID 2012b).

Existing or completed programs aimed at acquiring Project water rights have succeeded in purchasing about 25 percent of the Project's agricultural water rights. Additionally, this report has previously noted that temporary agricultural demand reduction programs are likely limited to a participation level of no more than approximately 30 percent. By limiting the extent of demand reduction to a maximum of 30 percent of agricultural water rights, it may be possible to consider applying a blend of temporary and permanent programs for some alternatives.

The preliminary alternatives that meet the water supply objective by relying on measures to reduce Project demand by 30 percent or more include 150.a, 150.c, 150.e, and 150.f, and all of the 0 cfs preliminary alternatives.

Use of Treated Effluent

The City of Fernley has noted that some alternatives may not be complete because they rely on the use of the city's treated effluent to serve Truckee Division agricultural needs, which would require a separate agreement that the city has not granted (City of Fernley 2012). Four preliminary alternatives contain this measure: 0.ay, 0.by, 0.cy, and 0.dy.

Effectiveness

Effectiveness is the extent to which an alternative alleviates identified problems.

All preliminary alternatives for the flow stages achieve a minimum level of effectiveness because they have been designed to meet both the safety and water supply objectives of the Study. Some are likely to be more effective than the Study requires. For instance, the 600 cfs preliminary alternative provides a higher level of water supply reliability than the Desired Reliability level.

Additionally, there appears to be an inherent, underlying contradiction in achieving the water supply objective by reducing the Project's overall demand for water. If part of meeting this objective is allowing Project users to exercise their water rights, it is likely that preliminary alternatives which do not rely on a high amount of water rights retirement achieve the goals of the Study more effectively. Although there is no firm line that can be drawn over which any additional land retirement attempts undermine the Study objective to serve water rights holders, this Study assumes preliminary alternatives containing less than 50 percent demand reduction are more effective than others. The 150.a preliminary alternative and all 0 cfs preliminary alternatives require reducing agricultural demand for Project water by at least 50 percent.

Efficiency

Efficiency is the extent to which an alternative is the most cost-effective and/or least complex means of alleviating the identified problems.

The preliminary alternatives differ significantly in their overall efficiency – the relative simplicity and cost effectiveness with which they meet the Study objectives. The least efficient preliminary alternatives include many of those developed for 150 cfs flow stage and the 0 cfs flow stage. This is because, in a broad sense, they tend to include some of the most complicated or most expensive actions needed to achieve at a minimum the same outcome as other less expensive and less complicated preliminary alternatives. For example, preliminary alternative 0.dz includes seven distinct measures; the low-end estimate for 0.dz's potential cost also exceeds the high-end cost for at least 17 of the other preliminary alternatives.

Additionally, preliminary alternatives that contain use of imported groundwater from Dixie Valley are, on average, much more expensive than other preliminary alternatives that rely on different measures to meet the water supply objective at the same flow stage.

To provide a contrast to these, the 600 cfs flow-stage preliminary alternative is likely the most efficient of any preliminary alternative because the safety objective is achieved with the lowest-cost fix for an active canal and the water supply objective is met by the flow stage itself. It includes the fewest and cheapest measures of any preliminary alternative.

The following preliminary alternatives achieve the Study objectives using more than three measures and/or do so at an annual cost of at least $15 million: 250.e, 150.d, 150.e, 150.f, and all of the 0 cfs preliminary alternatives. The preliminary alternatives that include the use of Dixie Valley are 350.c, 250.c, 150.c, 0.cy, and 0.cz.

Acceptability

Acceptability is the workability and viability of an alternative with respect to its potential acceptance by other Federal agencies, state and local government agencies, and public groups and individuals, as well as its compatibility with existing laws, regulations, and policies.

All alternatives are possible to implement under existing laws, regulations, and policies, although the implementation hurdles may differ. Acceptability of preliminary alternatives to various Federal, state, or local agencies and other groups varies consistent with those entities' diverse sets of interests and concerns – no preliminary alternative is highly acceptable or highly unacceptable to all groups. Considering acceptability of the preliminary alternatives by flow-stage category:

- For the 600 cfs preliminary alternative, acceptability is generally high, with one group (Pyramid Lake Paiute Tribe) likely to find it less acceptable, as this preliminary alternative would result in the most flows being diverted from the Truckee River and would also continue efficiency losses in the Fernley Reach of the Truckee Canal.

- The 350 cfs preliminary alternatives likely offer a medium level of acceptability for all entities, although acceptability may vary depending on the specific measures contained in each. While Project water users or other groups are unlikely to consider a 350 cfs flow stage the most attractive option, few will find it the most objectionable flow stage considered by the Study. This flow stage may perform at a slightly lower level of reliability than the 600 cfs flow stage, but the difference noticed by Project users is likely to be quite small.

- The 250 cfs preliminary alternatives offer, in general, low-to-medium levels of acceptability, for similar reasons as the 350 cfs preliminary alternatives.

- The 150 cfs preliminary alternatives are likely to carry low levels of acceptability for Project water users, but a higher level of acceptability for one group (Pyramid Lake Paiute Tribe). Review of the 150 cfs preliminary alternatives by agencies also yielded objections to 150 cfs from TCID due to potential injury to existing water rights and from the City of Fernley due to groundwater concerns (TCID 2012b; City of Fernley 2012).

- The 0 cfs preliminary alternatives also offer a generally low level of acceptability, with the exception of one group (Pyramid Lake Paiute Tribe), who is likely to find these alternatives highly acceptable due to the potential for large increases of flow to Pyramid Lake as a result of decommissioning the Truckee Canal. Many Project water users do not consider a 0 cfs flow stage an acceptable approach to meeting Study objectives (City of Fernley 2012, TCID 2012b).

Refinement of Alternatives that Rely on Demand Reduction

Alternatives 350.a, 250.a, and 250.d were originally formulated as preliminary alternatives which included some amount of reduction in Project demand to meet the Study's water supply objective. However, both the method of demand reduction (permanent retirement or dry-year fallowing of water-righted agricultural land) and the actual extent of demand reduction needed for each alternative was not identified.

As a result, once alternatives 350.a, 250.a, and 250.d were selected, the Study conducted an analysis to assist in determining which measure should be selected and the extent of its application (see Appendix F, "Performance of Selected Alternatives on Newlands Project Water Supply Reliability").

For Alternative 350.a, this analysis revealed that, given the historical cultural practice of irrigators to use a reduced (95 percent) portion of their maximum water rights volume, Alternative 350.a did not require additional demand reduction to achieve the water supply objective (see Chapter 3 and Appendix C for a discussion of this assumption).

The first set of analysis for both Alternative 250.a and Alternative 250.d assessed the effects of permanent water-righted land retirement on the water supply reliability for each alternative. The analysis scaled up the extent of retirement in 5-percent increments until the alternatives met or exceeded the Desired Reliability. For Alternative 250.a, 0 percent through 15 percent retirement were considered. For Alternative 250.d, 0 percent through 5 percent retirement were considered.

The second set of analysis for both Alternative 250.a and Alternative 250.d assessed the effects of dry-year fallowing on the water supply reliability for each alternative. This analysis also scaled up the extent of dry-year fallowing in 5-percent increments until the alternatives met or exceeded the Desired Reliability. Because dry-year fallowing programs are relatively less effective per acre than permanent retirement, a greater extent of temporary fallowing was assumed to be required to achieve equivalent levels of performance as permanent retirement. For Alternative 250.a, 20 percent through 25 percent fallowing during dry years were considered. For Alternative 250.d, 5 percent through 10 percent during dry years were considered.

Table 4-15. Type and Extent of Demand Reduction Identified for Alternatives 250.a and 250.d

	Permanent Retirement	Dry-Year Fallowing
Alternative 250.a	15%	25%
Alternative 250.d	5%	10%

To select between the permanent retirement and dry-year fallowing options, the Study team again considered how each may perform against the Federal planning criteria:

- Completeness: As noted previously, permanent retirement options may render some alternatives less complete due to concerns about the availability of willing sellers.

- Effectiveness: Permanent retirement and dry-year fallowing options are equivalent in their effectiveness at meeting the Study's water supply objective under alternatives 250.a and 250.d.

- Efficiency: Per-acre costs are lower for dry-year fallowing, but this approach generally requires about twice as much demand reduction as permanent retirement to meet the equivalent reliability goals. Ultimately, costs are higher for dry-year programs, making them less efficient.

- Acceptability: There is a potential for strong resistance to additional attempts to purchase water-righted agricultural land in the Truckee and Carson river basins, as acreage has already been reduced by water-rights purchase programs and large quantities of Project rights have been transferred to environmental uses. As dry-year fallowing is a temporary reduction in demand that does not diminish the overall size of the Project, this approach may be more acceptable to water rights holders, stakeholders, and others.

The above considerations led the Study team to select the dry-year fallowing options for Alternative 250.a (25 percent) and Alternative 250.d (10 percent).

Summary of Alternative Selection

Application of the planning criteria revealed that preliminary alternatives that rely upon canal decommissioning (0 cfs), a 150 cfs flow stage, Dixie Valley imports, or high levels of temporary or permanent water rights retirement appear to be outliers against criteria for completeness and efficiency. Preliminary alternatives that would retire at least half of the Project's water rights are also judged to be outliers for the effectiveness criterion. Application of the acceptability criterion did not eliminate any alternatives, but helped identify the levels of acceptability different entities may associate with the range of flow stages considered.

As a result, seven preliminary alternatives out of the initial list of 24 have been selected for further evaluation in the Study (Table 4-16).

Table 4-16. Summary of Preliminary Alternatives Performance Against Planning Criteria

Alt.	Completeness	Effectiveness	Efficiency	Acceptability	Retained for further consideration
600	High	High	High	Varies by Stakeholder and Agency	Yes
350.a	High	High-to-Medium	High-to-Medium	Medium	Yes
350.b	High	High-to-Medium	High-to-Medium		Yes
350.c	High	High-to-Medium	Low		
350.d	High	High-to-Medium	High-to-Medium		Yes
250.a	High	High-to-Medium	High-to-Medium	Medium-to-Low	Yes
250.b	High	High-to-Medium	High-to-Medium		Yes
250.c	High	High-to-Medium	Low		
250.d	High	High-to-Medium	High-to-Medium		Yes
250.e	High	High-to-Medium	Low		
150.a	Low	Low	High-to-Medium	Varies by Stakeholder and Agency	
150.b	Low	High-to-Medium	High-to-Medium		
150.c	Low	High-to-Medium	Low		
150.d	Low	High-to-Medium	Low		
150.e	Low	High-to-Medium	Low		
150.f	Low	High-to-Medium	Low		
0.ay	Low	Low	Low	Varies by Stakeholder and Agency	
0.az	Medium-to-Low	Low	Low		
0.by	Low	Low	Low		
0.bz	Medium-to-Low	Low	Low		
0.cy	Low	Low	Low		
0.cz	Medium-to-Low	Low	Low		
0.dy	Low	Low	Low		
0.dz	Medium-to-Low	Low	Low		

Key:
Alt. = Alternative Name

Scale

Lower Performance — Higher Performance

Chapter 5 Alternatives

This chapter provides an overview of the features and potential effects of the Without-Action Alternative and each of the action alternative plans selected for the Study (Study Alternatives). Of the 24 preliminary action alternative plans formulated in Chapter 4, the following seven were selected for further analysis and comparison as Study alternatives:

- Alternative 600 (600 cfs Truckee Canal)
- Alternative 350.a (350 cfs Truckee Canal)
- Alternative 350.b (350 cfs Truckee Canal plus lining a portion of the Carson Division's canals and laterals)
- Alternative 350.d (350 cfs Truckee Canal plus lining portions of the Truckee Canal)
- Alternative 250.a (250 cfs Truckee Canal plus land retirement)
- Alternative 250.b (250 cfs Truckee Canal plus lining a portion of the Carson Division's canals and laterals)
- Alternative 250.d (250 cfs Truckee Canal plus lining portions of the Truckee Canal and land retirement)

Each of the Study alternatives includes safety and water supply measures.

- **Safety Measures –** All alternatives include a set of actions to reduce risk to public safety from operating the Truckee Canal. These are identified in the Corrective Action Study and Risk Assessments (Reclamation 2011a-d), and summarized in Chapter 4, "Measures and Preliminary Alternatives." Each alternative includes the full set of measures required to meet the safety objective.
- **Water Supply Measures –** In addition to the actions to meet the safety objective, most alternatives also include actions to serve Project water rights holders with a certain level of reliability (Desired Reliability) into the future. These measures are derived from previous studies and reports, public and agency input, and Study team judgment, and are summarized in Chapter 4, "Measures and Preliminary Alternatives."

Each alternative includes the full set of measures included to meet the water supply objective.

This chapter describes the major components, accomplishments, and primary effects of each Study alternative. The accomplishments and effects of the Study alternatives are determined in comparison to the Without-Action Alternative, but may also be compared to the Desired Reliability condition where useful.

This chapter is organized in the following manner:

- **Evaluation Methods –** this section describes the methods used to characterize and assess the Without-Action and Study alternatives.
- **Alternative Descriptions –** in separate sections for each alternative, descriptions are provided for the major components and primary effects of the Without-Action and the seven Study alternatives.

Evaluation Methods

This section describes evaluation methods used to assess the features and effects of alternatives. Evaluation methods are described for plan formulation, engineering and cost estimates, water supply operations modeling, hydropower generation modeling, environmental and regulatory review, and economics and benefits assessments.

Plan Formulation

This Study used an iterative planning process to identify and evaluate more than 50 individual measures for their performance in contributing to the safety and water supply objectives. The measures were considered in a screening process that carried through three phases as documented in Chapter 4. The Study team combined the remaining measures to form twenty-four preliminary alternatives, to which the Study team then applied the Federal water resources planning criteria to select the seven alternatives described in this chapter.

Each Study alternative was assessed for its ability to meet the Desired Reliability in chapters 2 through 4. An alternative was considered sufficient in meeting the Desired Reliability when: (1) the largest deficit in delivery relative to the Desired Reliability condition was less than or equal to 10,000 acre-feet, and (2) the average of differences in delivery between the alternatives and the Desired Reliability was greater than zero. An in-depth discussion of the water supply performance of each alternative can be found in Appendix F.

Engineering and Cost Estimates

For each alternative, the Study has identified estimates for a variety of associated costs. All cost estimates presented are appraisal-level and at a January 2012 price level. Appraisal level cost estimates are developed for planning purposes, can be used for comparison of alternatives, and are not suitable for requesting project authorization or construction fund appropriations.

- **Field Costs –** Field costs represent an estimate of capital costs of a feature or project from award to construction closeout. Allowances for mobilization, design contingencies, allowance for procurement strategies (APS), and construction contingencies are included in field costs. Field costs for the alternatives are based on the costs developed for the measures that comprise the alternatives. Development of these costs is discussed in Appendix E2, "Initial Cost Estimates for Screening of Measures."

- **Non-contract Costs –** To determine the total construction cost for each alternative, non-contract costs were developed and added to the field costs. Non-contract costs refer to (1) costs of work or service provided in support of the implementation of a project, and (2) other work that can be attributed to the project as a whole, known as distributed costs. Non-contract costs were divided into five categories for this Study and are as follows:

  - **Planning and Environmental Compliance –** This includes collection, assembly, analysis of data, and preparation and review of additional planning studies, environmental impact reports, and environmental mitigation. This may also include preparation of feasibility design and cost estimates, surveying and design specifications, environmental oversight, and legal services.

  - **Engineering and Design –** This includes preparation and review of final designs, construction drawings, specifications, and construction cost estimates.

  - **Construction Management –** This includes engineering administration, management, coordination, and control of construction activities.

  - **Easements –** This includes any temporary construction easement requirements.

  - **Cultural Resources –** This includes coordination with Nevada SHPO, compliance documentation, and mitigation.

These non-contract costs were based on specific percentages of the field costs, and are described further in Appendix E3, "Appraisal Cost Estimates for Alternatives."

- **Capital Costs –** Capital cost represents the total cost of planning and constructing a project. It includes the field costs, non-contract costs, and interest during construction (IDC).

- **Annual Costs –** Total annual costs for each alternative were estimated by interest and amortization of the capital cost over 50 years and at the current Federal discount rate. Annual O&M costs were also estimated.

Allowances for escalation from published price levels through the construction contract were not included in these estimates because of the undefined schedule for alternative implementation. Escalation would need to be determined before authorization of Federal funding. In addition, development of feasibility level non-contract costs will likely require moving from percentage based allowances to detailed line items. All cost estimates, especially at this stage in the planning process, have inherent risks and uncertainties.

The methods and assumptions for developing these costs are further described in Appendix E2, "Initial Cost Estimates for Screening of Measures" and Appendix E3, "Appraisal Cost Estimates for Alternatives."

Water Supply and Operations Modeling

The Study relies upon the Pre-TROA Planning Model (Planning Model) to assess the effects of Study alternatives on the management of water supply and hydropower facilities within the Truckee and Carson river basins. The Planning Model is a daily-time step water management simulation model built in the RiverWare modeling environment. Simulations are performed over a 100-year period of simulation, based upon hydrology data for the 1901 – 2000 period of record. Hydrology data was recently updated to include an improved characterization of hydrologic variability on Truckee River tributaries, and the Planning Model has been updated to include this improved hydrology. The Planning Model considers operations of all major dams and reservoirs in Truckee and Carson basins, including Lake Tahoe, Donner, Independence, Boca, Prosser, Stampede, Derby, and Lahontan. Current flow and regulatory standards throughout the basins are included as constraints in the model, including OCAP. TROA is not represented in the Planning Model.

The Planning Model representation of the Project was revised for use in the Study. Separate representation was provided for demands among groups of Carson Division water users (M&I, agriculture, wetlands, and tribal uses). Demands for each user group were based upon the Study assessment of maximum, potentially active water rights which takes into account the completion of various water transfer, retirement program, and trends toward selling/dedicating rights (e.g., USFWS acquisition goals, AB380 retirement goals, and Truckee Division sales/dedications) and anticipates a demand for the full duty of all remaining Project water rights. A conceptual diversion was included at Derby Dam to account for the anticipated, full diversion of Project water rights by the City of Fernley.

Planning Model simulations demonstrate how changes in demand, infrastructure, or regulatory conditions could, in general, change conditions throughout the complex and interconnected Truckee and Carson river basins. The existing Planning Model operating rules were developed and refined to simulate the existing system. Inherently, computer models represent a simplified version of water resource systems and decisions made by water users, and may not fully capture the full range of possible decisions. Many unknowns exist concerning how water users will meet their institutional and regulatory commitments under some conditions simulated by the Study. Therefore, it is advisable that Planning Model results be used to provide general trends for comparing alternatives, instead of as predictions of absolute outcomes.

Results from the Planning Model are used as input to several other technical studies, including hydropower generation and economic assessments.

Several appendices to the Study provide further explanation of: the selection of the Planning Model (Appendix B1, “Operations Model Selection and Formulation”), the adaptation of Planning Model Hydrology (Appendix B2, “Revised 100-Year Hydrology”), and the assessment of potentially active water rights for various water user groups in the Truckee and Carson divisions (Appendix C, “Projected Future Water Rights and Demands for the Newlands Project”).

Hydropower Generation Modeling

Preliminary energy estimates for generation within the Newland Project at Lahontan Reservoir and 26-Foot Drop were made using a spreadsheet approach that used output from the water operations models developed for the Study. A simplified representation of hydropower facilities was created to capture relative changes in generation at Lahontan Reservoir and at the 26-Foot Drop facility on the V Canal. Key features of the hydropower generation analyses include the following:

- Monthly time-step calculations based on head and flow
- Generation unit capacity consistent with engineering assumptions
- Assumed peak and off-peak energy prices, as described in Appendix G1
- Calculated peak and off-peak power use, generation, and values

Further explanation of the methods developed to assess hydropower generation at the Lahontan and 26-Foot Drop powerplants are provided in Appendix B3, “Newlands Project Hydropower Generation.”

Accomplishments

The accomplishments noted for each alternative include how well it achieves the Study objectives (safety and water supply), and how it performs on key metrics of interest to Project water rights holders and stakeholders. The evaluation of accomplishments for each alternative is informed by the physical features of the alternative and the modeling and engineering analyses performed for the Study.

Safety

All alternatives formulated and selected by the Study to bring the urbanized portions of the Truckee Canal to meet the RR3 standard of safety, which is required for achieving the Study's safety objective; the Without-Action Alternative may somewhat meet the safety objective, although the degree to which is unknown.

Water Supply

For the purposes of this Study, alternatives are assessed against a desired level of reliability for the Newlands Project. The Desired Reliability is based upon simulations of water supply deliveries to the Newlands Project under a blend of historic and current conditions that include: the historic 900 cfs Truckee Canal capacity, historic hydrology for the Truckee and Carson basis from 1901 to 2000, current OCAP and other regulatory conditions in the Truckee and Carson river basins, and the Study's assessment of the current potentially active Project water rights. Under these conditions, the Desired Reliability results in 14 years with water supply deliveries below 95 percent of the total Project demand, average annual deliveries are 94.6 percent, and the lowest annual Project delivery is 40 percent of total demand (see chapters 2 and 3).

All Study alternatives meet or exceed the Desired Reliability; however, some may achieve higher levels of water supply deliveries than others. Desired Reliability described in Chapter 2, "Plan Formulation Process." Current demand is described in Appendix C.

Project Efficiency

Efficiency for the Newlands Project is defined as the amount of water released from Lahontan Reservoir for delivery into the Carson Division and the amount of water diverted into the Truckee Division laterals, relative to the actual headgate deliveries. This is consistent with the 1997 OCAP, previous OCAPs, and the 1994 Efficiency Study. For the Study, project water supply efficiencies are assumed to be 65 percent. Some alternatives increase the overall Project efficiency with the intent of creating additional water supply for Project water rights holders, as opposed to contributing to recoupment. Other alternatives may have the effect of increasing efficiency of Project features, such as the Truckee Canal, that are not included in the traditional Project efficiency calculation. This section of the alternative descriptions notes any anticipated increases in Project efficiency that would result from implementation.

Water Quantity and Quality on Lower Truckee River

In recent decades, through the negotiation of TROA and several settlement agreements, a number of actions have been taken to improve the water quantity, and thereby the water quality, in the lower Truckee River. The Pyramid Lake Paiute Tribe continues to seek additional opportunities to increase the quality and quantity of flows on the lower Truckee River. Some alternatives may increase the quantity, and thus the overall quality, of water in the Truckee River below Derby Dam that flows into Pyramid Lake. For each alternative, the description indicates the amount of water that will not be diverted at Derby Dam relative to the Desired Reliability condition and to the without-action condition.

Hydropower Generation

Hydropower generation accounts for a significant portion of TCID's annual revenue. Some alternatives reduce TCID's ability to generate hydropower because they reduce the flow and/or head elevations for the two power plants below Lahontan Reservoir, or because they reduce flow through the power plant at 26-Foot Drop powerplant on the V Canal. Each alternative's description approximates the alternative's effect on energy production for the facilities at these two locations.

Environmental and Regulatory Considerations Review

Identification of possible environmental outcomes for each alternative is based on a review of existing data, studies, and reports, including: NEPA documents for previous actions occurring in the project area; a high-level review of environmental conditions; public, stakeholder, and agency comments; and Study team judgment. Where possible, sources for this information are noted. The evaluation of environmental outcomes is preliminary and qualitative and is intended to identify potential issues that may arise if particular alternatives are implemented. Potential environmental outcomes would require more detailed evaluation at a later time and would presumably be addressed during the NEPA process.

Each alternative has been given a preliminary level of review and analysis to identify incidental outcomes that may reduce or elevate the alternative's implementation potential or attractiveness. This could include changes in species habitat or populations, cultural or historical resources, groundwater availability, air quality, or noise.

A preliminary summary of potential regulatory and permitting requirements was compiled based on a review of previous documents, including NEPA documents for previous actions occurring in the study areas, and based on the knowledge of Reclamation staff. A more complete determination of regulatory requirements would be identified later in the process following informal consultation with regulatory agencies.

Some alternatives have significantly different regulatory hurdles associated with them. The regulatory review section identifies the known or anticipated regulatory compliance and permitting requirements for the alternatives. Although a full assessment of regulatory requirements cannot be determined until alternatives are further developed and agencies consulted, a preliminary summary of potential regulatory coordination or permitting is provided in Table 5-1. Additional detail is provided in the “Regulatory Review” section under individual alternatives. Permitting and/or formal consultation may not be required for all of the regulations listed in the table; however, it is assumed that, at a minimum, informal consultation would occur with all agencies listed.

The Newlands Project is exempt from the Clean Water Act (CWA) (pursuant to 40 CFR § 122.3 and NAC 445A.228), and previous work on project canals has not required Section 401 or National Pollutant Discharge Elimination System (NPDES) permitting. Although CWA permitting requirements are not identified in the table below, it is assumed that the U.S. Army Corps of Engineers (USACE) would be included in informal consultation during the NEPA process, and any potential concerns related to CWA or other regulatory requirements under the jurisdiction of the USACE would be addressed at that time.

Table 5-1. Potential Regulatory Needs and Considerations for Study Alternatives

Regulatory Requirement	Regulatory Agency or Entity
Federal	
Endangered Species Act Consultation	U.S. Fish and Wildlife Service
Fish and Wildlife Coordination Act Consultation	U.S. Fish and Wildlife Service
Cultural Resources Consultation	Nevada State Historic Preservation Office
Indian Trust Resources Consultation	Pyramid Lake Paiute Tribe and Fallon Paiute-Shoshone Tribe
Rivers and Harbors Act Section 10	U.S. Army Corps of Engineers
Migratory Bird Treaty Act (16 U.S.C. 703 et seq.)	U.S. Fish and Wildlife Service
National Environmental Policy Act	The lead Federal agency would be determined at a later date, but may be assumed to be Reclamation.
Farmland Protection Policy Act	Natural Resources Conservation Service
Floodplain Management (Executive Order 11988), Protection of Wetlands (Executive Order 11990), and Federal Noxious Weed Control Act (Executive Order 13112, and 43 CFR 46.215 (l))	Various
State	
Surface Area Disturbance Permit	Nevada Division of Environmental Protection, Bureau of Air Pollution Control
Local	
Encroachment permits	Churchill, Lyon, and Storey counties

Key:
CFR = Code of Federal Regulations
U.S.C. = United States Code

Financial and Economic Analysis

An analysis was performed to assess TCID’s overall financial condition and estimate TCID’s ability to pay for the cost of actions to meet the safety and water supply objectives. Additionally, preliminary benefit categories were identified, and water supply-based economic benefits were quantified to determine the value of water supply to different categories of water uses in the Project. Quantitative analyses of anticipated economic benefits such as safety, and the effects of the alternatives on the regional economy, were beyond the scope of this Study.

TCID Ability-to-Pay

For the purposes of alternatives evaluation and comparison, the financial analysis included development of TCID’s ability-to-pay under each Study alternative. Ability-to-pay is defined as the farm-level payment capacity aggregated to the entire Project plus TCID’s hydropower revenues and non-operating revenues, minus TCID’s O&M costs, existing obligations, operations and maintenance costs, power costs, and reserve fund requirements. Analyses used to estimate TCID's ability-to-pay include:

- **Farm Payment Capacity –** Payment capacity is the estimated residual net farm income of irrigators after deduction for on-farm production and investment expenses, as well as appropriate allowances for management, equity, and labor. The Payment capacity analysis is intended to estimate the financial ability of farms to absorb additional water supply and management costs. For this analysis, farm crop budgets were prepared representing common crop rotations and several sizes of commercial farming operations within the Project. Available water supply for each Study alternative is assessed to determine if the changes in irrigation water supply result in changes in payment capacity.

- **Hydropower –** TCID operates two hydropower plants that generate power as water is delivered to farms and others in the Project. Electricity sales from power generation provide an important ongoing source of income to TCID. The water supply model provides estimates of power generation at the facilities according to water deliveries within the Carson Division. The power generation estimates are combined with electricity price information contained in the power sale contracts held by TCID to estimate annual power revenues for each alternative.

- **Financial –** The financial model combined financial statements for the most recent five-year period with output from the hydropower model and payment capacity analysis to estimate TCID's ability to pay.

As reported in Appendix G1, "Financial and Economic Analysis," the estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. The ability to pay currently and under each alternative relies substantially upon current and recent crop prices, which are volatile. For example, if alfalfa prices fell from current levels ($155 per ton) to levels experienced a decade ago ($125 per ton), TCID's ability to pay could be reduced by as much as $8.7 million per year. Ability to pay estimates represent potential maximum increases to charges that TCID could apply to their customers and maintain farm profitability, and are not reasonable to use as the sole basis for capital investment decisions.

A full description of this process and related assumptions, as well as information related to TCID's overall financial condition, is found in Appendix G1.

Preliminary Benefits Estimates

Five categories of benefits were identified in relation to the Study alternatives to illustrate the potential economic effects of the alternatives: safety, hydropower generation, and water supply for agricultural, M&I, and environmental/wetlands uses. Where, possible, these benefits have been quantified for the Study alternatives in relation to the Without-Action Alternative.

The economic analyses conducted for this Study are preliminary, and less detailed than what would be anticipated for a full feasibility study. It is widely recognized that the Truckee Canal has a strong influence on the regional economy. However, an evaluation of the regional incidence of economic effects, income transfers, and employment, which would be reported under the Regional Economic Development (RED) account in a feasibility study, is beyond the scope of this Study.

Safety Reclamation has found that the Without-Action Alternative likely reduces some portion of risk along the urbanized portions of the Truckee Canal near the City of Fernley. All of the Study Alternatives have been designed to meet the RR3 standard of safety, and are assumed to perform equally in this capacity.

Economic studies of alternatives that seek to improve public safety or reduce the occurrence of flooding often estimate the value of these improvements though “life safety” or “flood damage reduction.” However, quantitative evaluation of these benefits has not been performed and is beyond the scope of this Study. The City of Fernley is the primary beneficiary from the safety improvements to the Truckee Canal in terms of reduced flood risk, but addressing the safety concerns in the Truckee Canal is also closely tied to the water supply benefits, as it would allow the canal to be operated at a higher capacity and provide a more reliable water supply for the Project.

Agricultural Water Supply The benefits of agricultural water supply reliability provided by the alternatives are the increase in value of agricultural outputs (crop yields), when comparing Study alternatives to the Without-Action Alternative. To estimate the direct economic value from additional water supply reliability to agricultural users in the Project, the Study applied the payment capacity analysis results as a preliminary measure of the agricultural benefits of the alternatives. The benefits to noncommercial farms are estimated as the weighted average benefits estimated for commercial farms, consistent with the payment capacity analysis described above and in Appendix G1. . The benefits are measured as the increase in value between the Without-Action Alternative and the Study alternatives. The adjustments made to reach the agricultural water supply benefit under each Study alternative is reported in Appendix G2, “Preliminary Benefits Estimation.”

M&I Water Supply The M&I water supply benefits analysis applies observed water right market prices within the Truckee and Carson divisions to estimate M&I benefits. This approach is consistent with the “cost of the most likely alternative” approach in the P&G as agricultural water rights are commonly acquired by municipal water providers and real estate developers for M&I uses.

The economic value has been estimated at a unit price of $1,500 per acre-foot for the Carson Division, and between $4,000 and $6,000 per acre-foot for the Truckee Division. The benefits are estimated as the difference in economic value between the Study alternatives and Without-Action Alternative. Development of these values is described in Appendix D8, “Market Value of Non-diverted Water Under a 0 cfs Truckee Canal,” and Appendix G2, “Preliminary Benefits Estimation.”

Environmental/Wetlands Water Supply To estimate the benefits associated with changes in water supply for environmental uses, this analysis considers the costs associated with developing alternative sources of environmental water supply to support wetland functions in the Carson Division. The USFWS has been purchasing water rights from willing agricultural sellers for many years to augment water supplies to wetlands, and the value of the benefit of water supply to Lahontan Valley wetlands is based on USFWS water rights purchases. Changes in water supply (Project deliveries and spills from Lahontan Dam) associated with the Study alternatives may result in a corresponding increase or reduction in water right acquisition volume to achieve wetland water supply goals. As a result, the costs associated with the water right purchases are used in this analysis as a preliminary indication of the benefits. This benefit has been estimated to a unit price of $1,756 per acre-foot, as reported in Appendix G2, “Preliminary Benefits Estimation.”

This analysis does not factor in added or reduced benefits due to potential changes in groundwater or drain flows that may result from implementation of actions in certain Study alternatives. Drain flows provide a portion of usable flows for the wetlands estimated at about 3,000 to 5,000 acre-feet per year (Richard Grimes, USFWS, personal communication, January 6, 2012).

Hydropower The hydropower benefit is the increase in revenue from hydropower generation that may result under different Study alternatives as compared to the Without-Action Alternative. Development of these estimates is described in Appendix G1, “Financial and Economic Analysis.”

Implementation Considerations

A variety of potential actions, responsibilities, and participants may be involved in implementing any of the alternatives, depending on an alternative’s components and features.

For each alternative, the Study has provided a preliminary assessment of the alternative’s compatibility with existing laws, policies, and plans. All the alternatives have been formulated to respect current State and Federal laws and policies, and are compatible with OCAP. Necessary regulatory or environmental compliance is also noted, but also described in the “Environmental Outcomes” and “Regulatory Review” subsections of this chapter.

Additionally, each description identifies the range of agencies or other entities who might be involved in implementation or cost-sharing. While Reclamation would likely participate in any action related to the Newlands Project, other Federal agencies, State agencies, local or regional agencies, and tribes could also participate in significant portions of an alternative's planning and implementation. Typically, Federal planning processes identify potential non-Federal partners to share the cost of implementing an alternative based on the relative benefits received by the potential partners. Such costs could include planning, permitting, construction, and occasionally O&M costs for the completed project. This Study does not attempt to allocate specific costs to be paid by different entities under each alternative; rather, the evaluation for each alternative merely notes those entities who might participate as a cost-share partner with Reclamation based on the benefits they receive or based on other specific interests.

Without-Action Alternative

The Without-Action Alternative represents future conditions that are likely to occur if none of the action alternatives are implemented, and is the basis for comparison with potential action alternatives, consistent with the P&G. It is intended to account for existing facilities, conditions, land uses, and reasonably foreseeable actions expected to occur in the primary study area in the future. Reasonably foreseeable actions include actions with current authorization, secured funding for design and construction, and/or environmental permitting and compliance activities that are substantially complete. Thus, if no action is selected for implementation by the Federal government, local governments, or other parties, the Without-Action Alternative is the likely default option.

The likely future restriction on the Truckee Canal's capacity is a central feature in the Study's Without-Action Alternative. Consistent with Federal planning guidelines, the Without-Action Alternative represents the likely future conditions—including the anticipated implementation of programs and projects that are authorized and funded—if no proposed action is taken. At present, there are no funded plans for reducing the identified risks on the Truckee Canal for depths at or above a flow stage of 150 cfs.

Components and Features

Under the Without-Action Alternative, the Truckee Canal is restricted to a 150 cfs flow stage within the Fernley Reach, consistent with Reclamation's allowance following the 2008 Truckee Canal breach (see the "Infrastructure" and "Water Resources" sections of Chapter 3).

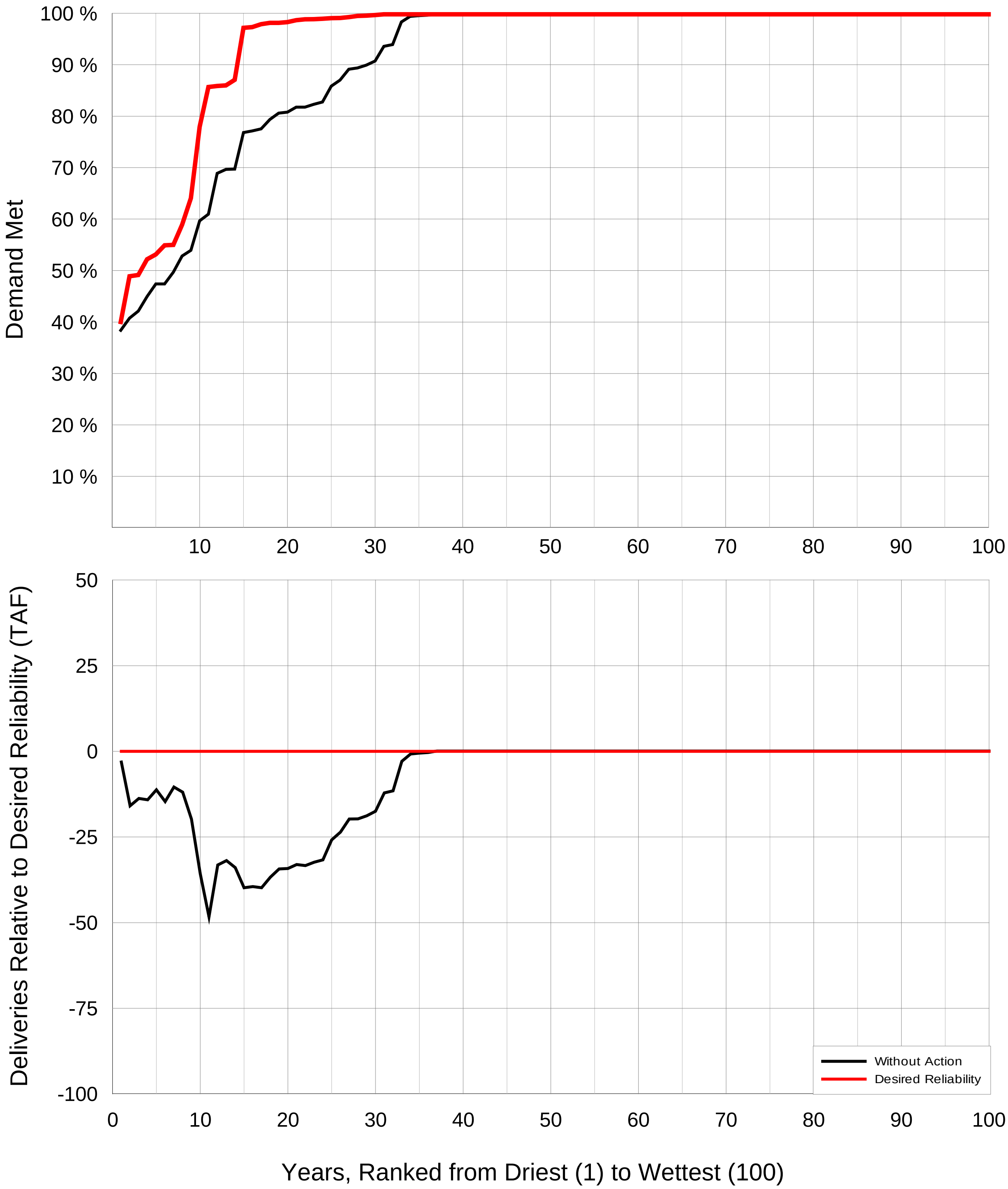
Accomplishments

Safety

The degree to which the Without-Action Alternative includes a safe flow stage in the Truckee Canal is uncertain. The 150 cfs flow stage is believed to pose a lower risk to the Fernley area. By operating the canal features to limit the flow stage to 150 cfs through the Fernley Reach, the water elevation in the canal is maintained at a level low enough to minimize the risk of destabilizing the canal embankment due to animal burrows and other pathways that might encourage internal erosion of the structure. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the Study's safety objective (RR3) is unknown.

Water Supply

The Without-Action Alternative does not meet either of the two conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (90.5 percent) is less than the desired reliability (94.6 percent); (2) as shown in Figure 5-1, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-48,000 acre-feet, which exceeds the desired negative-10,000 acre-foot threshold.



Key:
TAF = thousand acre-feet

Figure 5-1. Water Supply Performance of the Without-Action Alternative

Project Efficiency

Project efficiency is assumed to be 65 percent and is unchanged under the Without-Action Alternative.

Water Quantity and Quality on Lower Truckee River

The Desired Reliability represents the historical hydrology and current operating conditions for the Newlands Project. With this condition, the annual average lower Truckee River flow volume is 470,000 acre-feet. The Without-Action Alternative, which diverts less water into the Truckee Canal than under the Desired Reliability, increases this volume to an annual average of 516,000 acre-feet on the lower Truckee River.

Hydropower Generation

The long-term average annual hydropower generation is estimated to be 13,906 MWh at Lahontan Powerplant and 4,561 MWh at 26-Foot Drop Powerplant in the Without-Action Alternative. This is significantly lower than the average annual generation under current conditions, which is approximately 16,500 MWh (see Appendix B3).

Preliminary Alternative Review

Under the Without-Action Alternative, Truckee Canal flows would be lower than under current conditions. As a result, Truckee River flows below Derby Dam and inflows into Pyramid Lake would be higher than current levels. Lahontan Reservoir inflows and releases into the Carson Division would be lower than current conditions.

Environmental Outcomes

Under the Without-Action Alternative, listed fish in the Truckee River and Pyramid Lake would benefit from increases in water quantity and quality as compared to current conditions. Wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake would also receive benefits of increased water availability. Other fish and wildlife that depend on wetland and riparian resources in the Truckee River and Pyramid Lake would benefit from these changes in habitat. In contrast, wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may decrease in extent due to lower water availability. Non-listed fish species and other wildlife species that use the Lahontan Reservoir and Carson Lake would experience decreases in water quality and quantity (Reclamation 2000).

As compared to the current and historical conditions, the Without-Action Alternative would be expected to have some effects on the local and regional economy, with potentially less long-term agricultural production. Additionally, it is likely that Fernley's M&I water supply, which currently is derived from groundwater, would be substantially reduced under the Without-Action Alternative (City of Fernley 2012).

No agricultural land retirement or fallowing is planned to occur under this scenario; rather, it is assumed that water efficiencies, including reuse of agricultural drain water, would increase to offset decreases in the quantity of water available for diversion. The reduction in irrigation return flows would reduce groundwater availability, as compared to current levels.

No substantial changes in land use or land cover are anticipated to occur under this scenario; therefore, no substantial changes in air quality from agricultural activities or changes in the extent of fallow land are expected to occur.

No construction would be associated with this scenario; therefore, tree removal would not be required, and no short-term effects to air quality or noise would result from equipment usage.

Regulatory Review

No construction activities or administrative changes are proposed under this alternative; therefore no regulatory compliance activities would be required.

Economics

TCID Ability to Pay

Under the Without-Action Alternative, TCID's ability to pay is estimated at $5.00 million annually. This assessment represents an approximately 23 percent reduction in ability to pay from current conditions ($6.5 million).

Implementation Considerations

See the "Regulatory Review" section above. No implementation considerations would be relevant under the Without-Action Alternative, as implementation activities are not required.

Alternative 600

Components and Features

The safety measure for Alternative 600 also meets the water supply objective. The allowable maximum flow stage in the Truckee Canal under this alternative, 600 cfs, fully meets the future demand of the Project.

Safety

HDPE Cutoff Wall The primary action to achieve safety is to install a HDPE cutoff wall within the Truckee Canal's embankment in:

- 1.7 miles of the Derby Reach of the canal (between station (STA) 409+75 to 411+00, 418+00 to 425+00, 433+00 to 445+00, 469+00 to 502+00, and 525+00 to 543+10)
- The entire Fernley Reach (11.1 miles, from STA 543+10 to 1126+40)
- 4.2 miles of the Lahontan Reach (from STA 1126+40 to 1260+00, 1270+00 to 1288+00, 1294+00 to 1300+00, and 1302+00 to 1340+00)

Truckee Canal station locations noted above can be located on Figures 5-2 through 5-4.

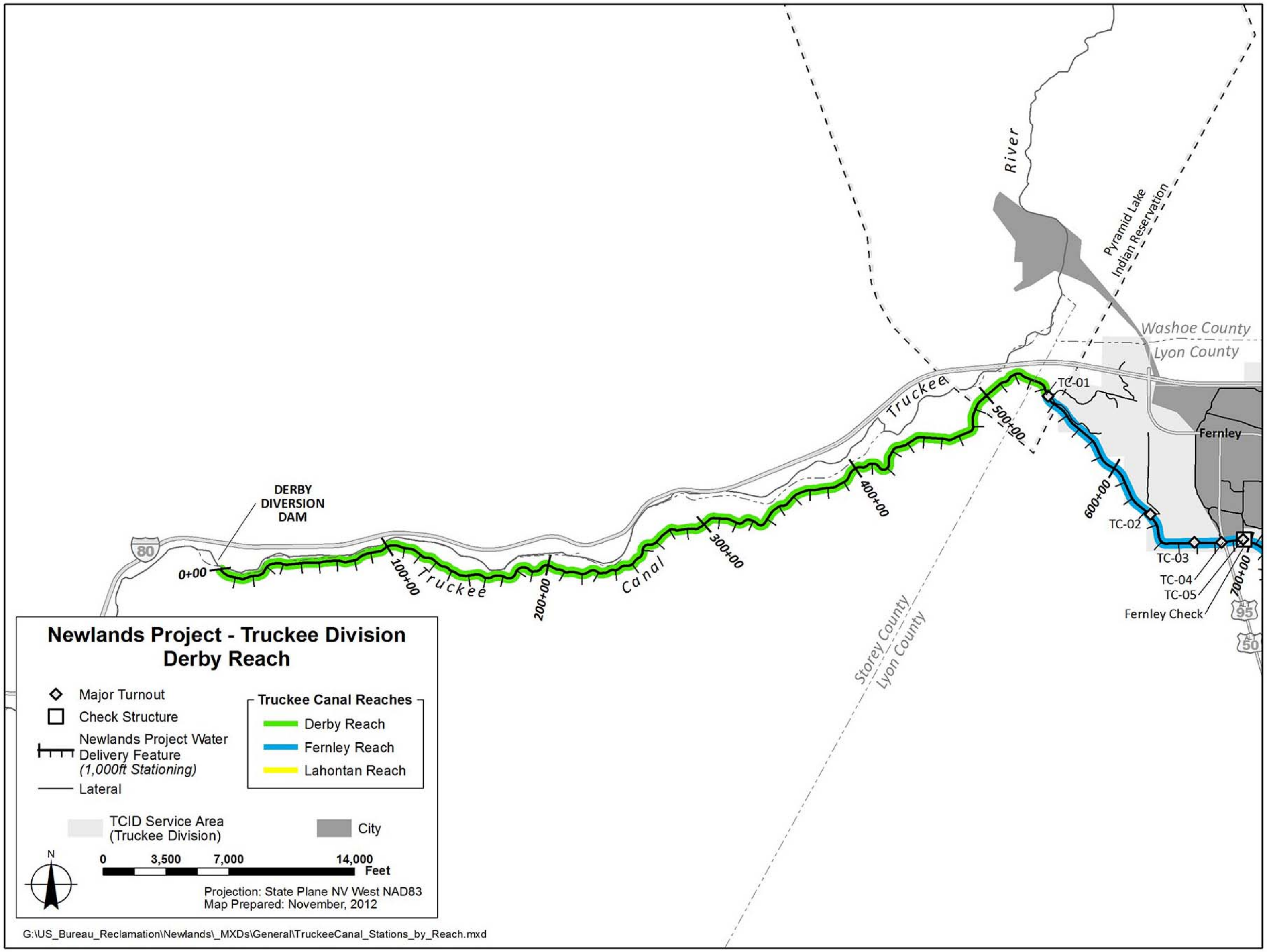


Figure 5-2. Truckee Canal Stationing, Derby Reach

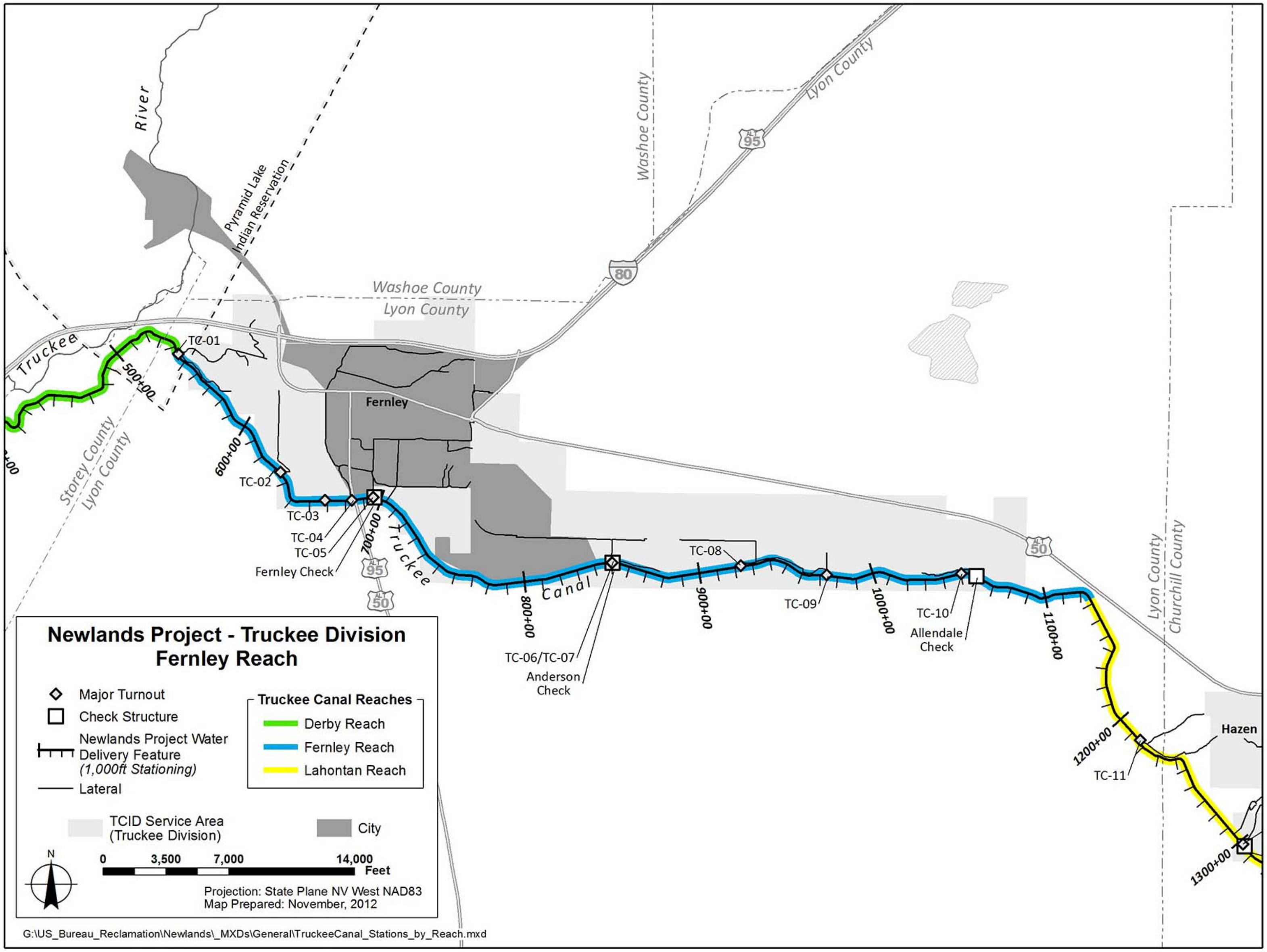


Figure 5-3. Truckee Canal Stationing, Fernley Reach

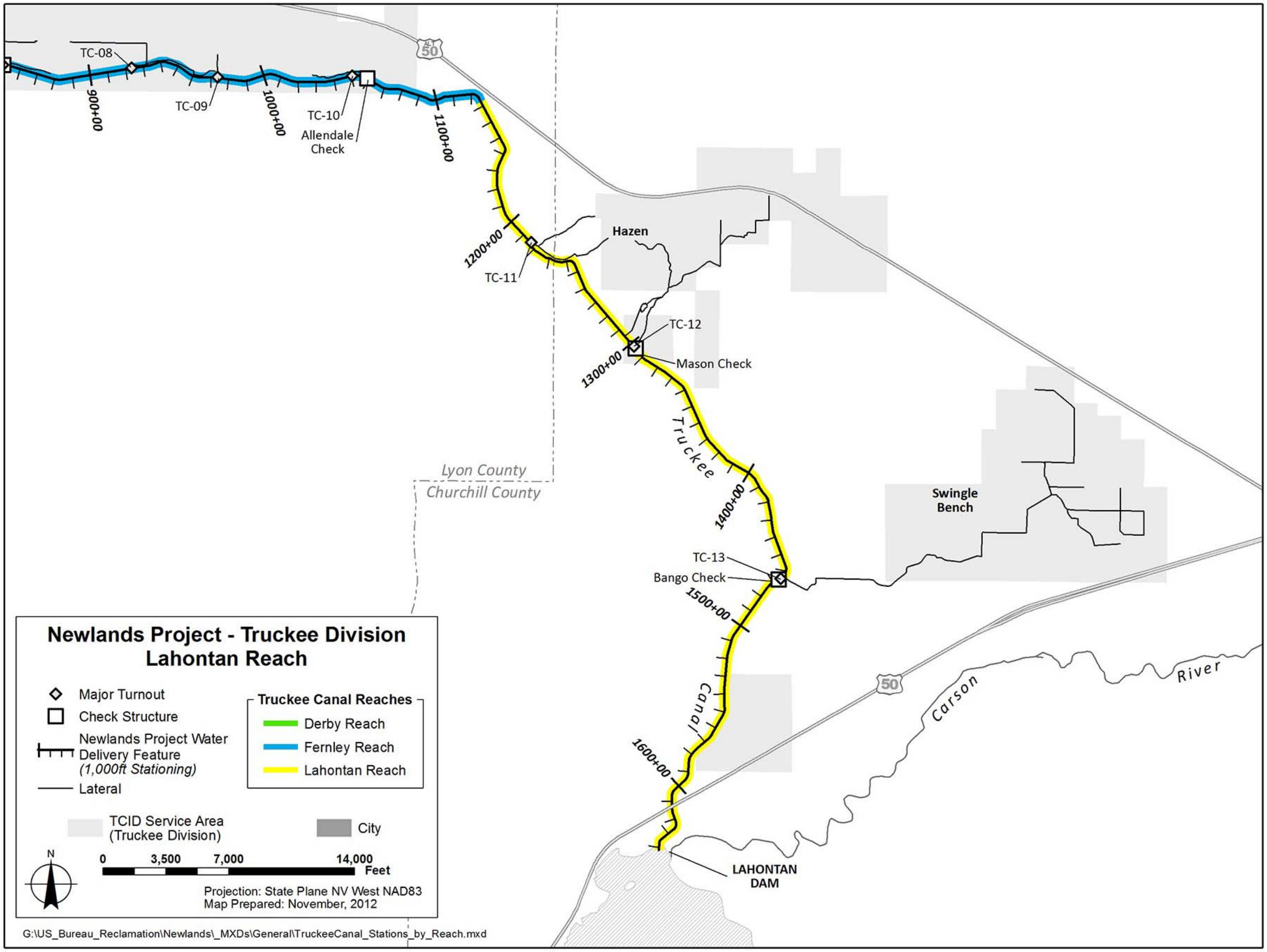


Figure 5-4. Truckee Canal Stationing, Lahontan Reach

The HDPE wall would provide a vertical barrier against seepage through the canal through the installation of panels joined with an interlocking system at each joint. The HDPE wall would be pushed and vibrated into the centerline of the canal. No trenching would be needed for installation.

Other Structural Improvements Additional actions to achieve the safety objective for this alternative:

- Replace each turnout pipe in the canal: nine in the Fernley Reach (at STA 578+66, 641+09, 668+58, 695+60, 728+50, 822+13, 848+82, 1003+54, and 1057+84) and two in the Lahontan Reach (at 1302+39 and 1465+06). The turnouts would be designed with the appropriate canal water surface elevation for delivering the required turnout flows. A new turnout structure with slide gate will be installed with the required pipe diameters designed to deliver the flow needed. A sand filter collar would be installed along a portion of the outlet side of the pipe. Riprap protection within the canal bank on either side of the structure would prevent animals from burrowing around the structure.[1]

- Replace all stock water line systems, and combine existing stock watering pipes with the new turnouts where applicable.[1]

- Replace four check structures in the Fernley Reach (Fernley, Anderson, and Allendale checks) and Lahontan Reach (Mason Check) with new, automated check structures.

- Remove the abandoned Pyramid (Derby) Check.

- Install a new check structure upstream from TC-1.

- Install five cross-drainage structures in the Derby Reach (at STA 28+00, 93+00, 180+00, 266+65, and 464+50).

- Install 10 wasteway turnout structures in the Fernley Reach (STA 544+33, 589+53, 633+70, 684+00, 795+15, 850+14, 923+58, 973+70, 1050+40, and 1100+00).

- Increase the canal bank height along 1.9 miles of the Lahontan Reach (from STA 1200+00 to 1302+00).

- Install a concrete geomembrane lining system over each utility crossing.

[1] These actions were identified by Reclamation in the Corrective Action Study (Reclamation 2011e) before TCID replaced the Truckee Canal's turnouts with new structures that include both stock line and delivery features. This canal conduit rehabilitation work occurred in 2012 and likely satisfies a portion of the safety objective the alternatives seek to achieve.

- Remove up to 115 trees located within 15 feet of the downstream toe of the landside slope in the Fernley and Lahontan reaches.

Replacement of existing canal appurtenance structures and new canal appurtenance structures provides risk reduction for several Truckee Canal failure modes (see Chapter 3). The cross-drainage structures will convey rainfall runoff across the canal and into the Truckee River in the Derby Reach. The new check structures will replace the existing checks to provide large check openings and gates to pass ice-jammed flows and flood flows. They will also allow for elevated water levels above the normal operating level to bypass the check gates by overflowing weirs on either side of the gates. The wasteway turnout structures combine an overflow weir and turnout into one structure that provides protection against overtopping of the canal, as well as normal diversion delivery flow to irrigators.

Cost Estimates

The total annual cost for Alternative 600 is $2.9 million.[1] The following table identifies estimates for non-contract costs; and total construction, capital, and annualized costs.

[1] This cost does not reflect a potential reduction that may result from TCID's 2012 activities to replace turnout structures on the Truckee Canal. Replacement of these structures likely satisfies a portion of the actions to achieve the safety objective and could reduce the field cost by $1.7 million, which is not reflected here.

Table 5-2. Alternative 600 Cost Summary

Measure Selected for Meeting the Safety Objective	Additional Measure(s) Selected for Meeting the Water Supply Objective	Estimated Cost ($ Million)
HDPE Cutoff Wall		$44.0
	no additional measures selected	-
TOTAL FIELD COST		**$44.0**
Non-Contract Costs		
Planning and Environmental Compliance[1]		$4.40
Engineering and Design[2]		$4.40
Construction Management[3]		$4.40
Easements[4]		$0.45
Cultural Resources[5]		$1.35
TOTAL CONSTRUCTION COST		**$59.0**
Interest During Construction[6]		$2.00
TOTAL CAPITAL COST		**$61.0**
Interest and Amortization[7]		$2.80
Annual Operations and Maintenance[8]		$0.10
TOTAL ANNUAL COST		**$2.90**

Note:

Cost estimate is appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimate is presented in January 2012 dollars, and may have discrepancies due to rounding.

[1] 10 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs.

[2] 10 percent of the field cost was estimated for Engineering and Design non-contract costs.

[3] 10 percent of the field cost was estimated for Construction Management non-contract costs.

[4] 1 percent of the field cost was estimated for Easements non-contract costs.

[5] 3 percent of the field cost was estimated for Cultural Resources non-contract costs.

[6] Interest During Construction was estimated over 2 years of construction at the current Federal discount rate of 4 percent.

[7] Interest and Amortization of the capital cost was estimated over 50 years at the current Federal discount rate of 4 percent.

[8] Annual Operations and Maintenance costs were estimated at 0.2 percent of the field cost.

Key:

$ million = million dollars

HDPE = high-density polyethylene

Accomplishments

Safety

Alternative 600 and all other alternatives formulated and selected by the Study meet the RR3 level of risk reduction required to achieve the Study's safety objective.

Water Supply

Alternative 600 meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (96.5 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure 5-5, deliveries for Alternative 600 exceed those for the Desired Reliability for each of the 100 years evaluated.

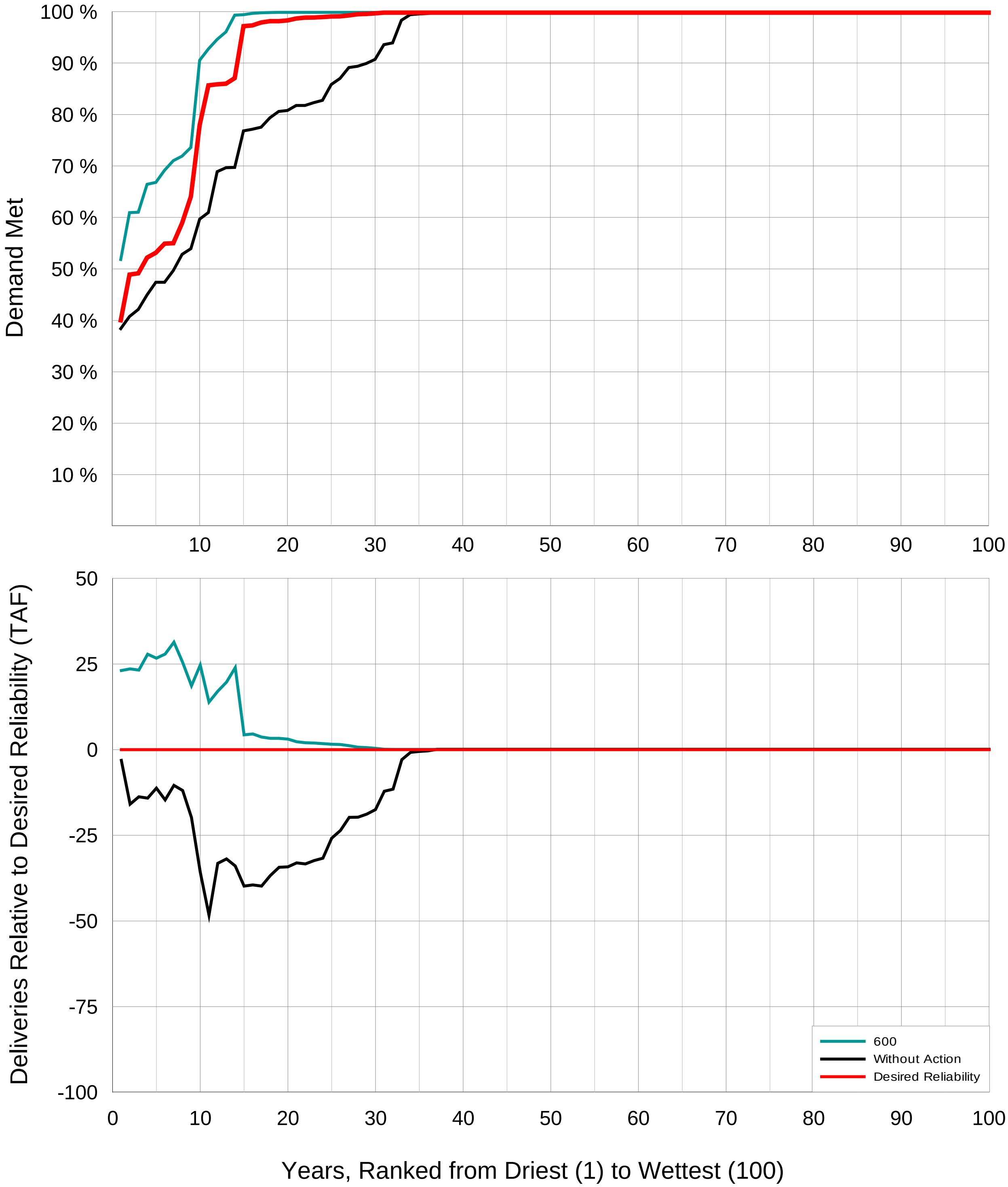


Figure 5-5. Water Supply Performance of Alternative 600

Project Efficiency

Alternative 600 plans for a Project efficiency of 65 percent, and includes no actions to increase efficiency.

Seepage losses from the Truckee Canal are not reduced under this alternative.

Water Quantity and Quality on Lower Truckee River

The average annual volume of water in the lower Truckee River does not differ greatly between the Desired Reliability condition and Alternative 600.

- **Relative to the Desired Reliability –** Increase in Truckee River flow of 10,000 acre-feet annually.

- **Relative to the Without-Action Alternative condition –** Decrease in Truckee River flow of 36,000 acre-feet annually.

Hydropower Generation

Hydropower generation is increased under Alternative 600 relative to the Without-Action Alternative. Average generation at Lahontan Powerplant and 26 Foot Drop powerplant is 16,227 MWh and 4,920 MWh annually, respectively.

Preliminary Alternative Review

Under Alternative 600, the volume of water diverted into the Truckee Canal would be greater than under the Without-Action Alternative. As a result, wetlands and environmental conditions in the Project would be improved. Relative to Without-Action Alternative, Lahontan Reservoir inflows would increase and the volume of water in the Truckee River below Derby Dam and inflows into Pyramid Lake would decrease. Safety modifications to the Truckee Canal required to accommodate the flow would trigger regulatory compliance requirements.

Environmental Outcomes

Compared to the Without-Action Alternative, under Alternative 600, wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may increase in extent due to greater water availability. Fish species and other wildlife species that use the Lahontan Reservoir and Carson Lake would experience increases in water quality and quantity that may improve habitat quality and prey availability. Listed fish in the Truckee River and at Pyramid Lake would experience decreases in water quantity and quality under Alternative 600 as compared to the Without-Action Alternative. Wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake may decrease in extent due to decreased water availability. Other fish and wildlife that depend on wetland and riparian resources in the Truckee River and Pyramid Lake could be adversely affected by these changes in habitat.

Under Alternative 600, return flows and groundwater availability may increase in the Carson Division compared to under the Without-Action Alternative.

Increased water availability within the Carson Division and return flows from agricultural users would benefit Stillwater NWR. No substantial changes in land use or land cover are anticipated to occur under this scenario; therefore, no substantial changes in air quality from agricultural activities or changes in the extent of fallow land are expected to occur.

The City of Fernley relies on seepage from the Truckee Canal to replenish the local aquifer, which is used for municipal and industrial water. Studies have estimated that a minimum flow of 350 cfs is needed in the Truckee Canal to accommodate the level of aquifer recharge required for the City of Fernley to continue receiving an adequate level of municipal water withdrawals (City of Fernley 2012). The 600 cfs alternative meets the City of Fernley's aquifer recharge needs, although this is not a valid Project delivery.

Construction effects from the Truckee Canal safety improvements could result in temporary effects to air quality from construction machinery, primarily related to fugitive dust from traveling on unpaved roadways adjacent to canals, and increased noise levels. Because the Truckee Canal is part of the NRHP-listed Newlands Project, planned improvements would need to be evaluated to determine that they do not negatively affect the aesthetics of historical importance of structures. Construction activities could affect water quality by the introduction of sediment and petrochemicals from machinery. The majority of the construction activities would occur in moderately populated areas, and there is potential for construction noise to disturb nearby residents in some places. It is assumed that noise mitigation measures, such as construction work windows and/or muffling of equipment would occur, if necessary.

Regulatory Review

A list of Federal, State, and local regulations that may be applicable to all alternatives is summarized in Table 5-1.

Federal Requirements Due to the presence of LCT and cui-ui in the extended study area, it is expected that Reclamation would initiate informal consultation with USFWS to determine any potential compliance requirements related to the ESA. Although it is not anticipated at this time, if it is determined that there is potential for adverse effects to listed fish, formal consultation and a biological assessment would be required. Informal consultation with USFWS would also address potential effects to non-listed species covered under the Migratory Bird Treaty Act or Fish and Wildlife Coordination Act from habitat changes, such as potential land bridge formation in Lahontan Reservoir and removal of trees that could provide nesting and roosting habitat.

Informal consultation would also occur with the USACE, although the Newlands Project is exempt from the CWA and, therefore, it is not anticipated that USACE permits would be required. Consultation would be required to address potential effects associated with Indian Trust Assets because some construction activities may take place on Pyramid Lake Paiute Tribal land or could indirectly affect Fallon Paiute Shoshone Tribe resources in the extended study area.

Because the Newlands Project is listed in the NRHP, consultation with the Nevada SHPO would be required to identify and mitigate potential negative effects to historic structures.

NEPA compliance would be required to assess the environmental effects of the proposed alternatives. Because no administrative changes in water rights are expected, and construction effects would not be extensive, an Environmental Assessment (EA) may be determined to be sufficient to evaluate effects. A public scoping process would be included as part of the NEPA process.

State and Local Requirements State and local permits would be required for construction-related activities, including a Surface Area Disturbance Permit from Nevada Department of Environmental Protection (NDEP), Bureau of Air Pollution, if over 5 acres are disturbed. If Truckee Canal safety improvements occur within a county right-of-way or road easement (within 30 feet of a county road), an encroachment permit would be required from Lyon, Storey, or Churchill counties.

Economics

TCID Ability to Pay

Under Alternative 600, TCID's ability to pay is estimated at $7.30 million annually. This is an improvement over the Without-Action Alternative of approximately $2.30 million.

Preliminary Benefits

All preliminary benefits for Alternative 600 are estimated in relation to conditions under the Without-Action Alternative. Although not quantified in the Study, safety to the City of Fernley is a primary benefit of Alternative 600. Benefits to agricultural, wetlands and M&I water supplies factor in the average water supply reliability of 96.5 percent that occurs under Alternative 600. Average annual revenue from hydropower generation increases $0.18 million over the Without-Action Alternative. The annual benefit of increased agricultural water supply for the Project is estimated at $1.20 million. The annual benefit of increased supply to wetlands is $0.51 million. The annual benefit of increased M&I supply is estimated at $0.01 million.

Implementation Considerations

Compatibility with Applicable Laws, Policies, and Plans

Alternative 600 is anticipated to be compatible with all existing laws and policies. It is also compatible with recent Truckee Canal rehabilitation actions taken by TCID to remove the 33 existing conduits to the laterals and replace them with 17 structures that include both lateral and stock line delivery features (TCID 2012b).

The range of environmental outcomes is more limited under this alternative than other alternatives evaluated, and may be able to be evaluated in an EA (see "Preliminary Alternative Review" subsection above).

Federal and Non-Federal Roles and Responsibilities

Reclamation would likely be the Federal lead for permitting and NEPA compliance. As the local contractor, TCID would likely obtain State and local permits related to construction activities.

Potential for Cost-Sharing

TCID TCID should be considered a potential cost-share partner because Alternative 600 significantly increases the water supply reliability experienced by its customers, which in turn improves its hydropower generation capacity – one of the largest sources of annual revenue for the district.

City of Fernley The City of Fernley should be considered as a potential cost-share partner for this Study alternative. The benefit of life safety and averted flood damage reduction would serve as a portion of the benefit that the city derives from Alternative 600. Additionally, Fernley receives the incidental benefit of continued seepage from the Truckee Canal into the local aquifer. By implementing this alternative, instead of another alternative that lines the Truckee Canal and reduces seepage, the city avoids the cost of replacing the groundwater supplies that they rely on.

Summary of Alternative 600

Table 5-3 below summarizes the performance, accomplishments, benefits, costs, and other characteristics of Alternative 600.

Table 5-3. Characteristics of Alternative 600

		Alternative 600	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	600 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	HDPE Cutoff Wall	-	NA
	Other Features	-	-	NA
Safety		Meets RR3	Uncertain[11]	NA
Average Annual Project Water Delivery[1] (percent)		96.5%	90.5%	94.6%
Average Annual Project Water Delivery by User Category	Ag/Irrigation (TAF)	118.3	111.2	NA
	M&I (TAF)	13.3	13.2	NA
	Lahontan Valley Wetlands[2] (TAF)	68.0	63.6	NA
Annual Cost[3] (millions)		$2.90	NA	NA
TCID Ability-to-Pay[12] (millions)		$7.30	$5.00	NA[9]
Preliminary Benefits[5] (annual)	Agricultural Water Supply Reliability (millions)	$1.20	NA	NA
	Wetlands/ Environmental Water Supply Reliability[4] (millions)	$0.51	NA	NA
	M&I Water Supply Reliability (millions)	$0.01	NA	NA
	Hydropower Generation Revenue (millions)	$0.18	NA	NA
	Safety[6]	Increased	NA	NA
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[7]	12.6	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[10]	Significant change not anticipated	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[8] (percent)	115%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	480	516	460[13]

Table 5-3. Characteristics of Alternative 600 (contd.)

Notes:

[1] Long-term average annual percent of Newlands Project demand met.

[2] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[3] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[4] Based on volume of deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR, and also spills to Stillwater from Lahontan Dam. Excludes consideration of water supply from return flows and groundwater.

[5] Preliminary benefits were estimated as the change between a Study alternative and the Without-Action Alternative for agricultural water supply, wetlands water supply, M&I water supply, and hydropower generation revenue. Water supply reliability under each Study alternative is factored into that alternative's benefits calculation. Benefits reported are annual, estimated over 50 years at the current Federal discount rate of 4 percent. For additional information, see appendixes D8, G1, and G2.

[6] The benefits of improved safety have not been quantified for this Study, but would need to be more fully evaluated for a feasibility study or for cost-allocation purposes.

[7] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[8] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[9] Assessment of financial conditions was not conducted for the Desired Reliability scenario, because this scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

[10] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[11] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the safety objective (RR3) is unknown.

[12] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[13] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:

Avg. = average
cfs = cubic feet per second
M&I = municipal and industrial
NA = not applicable
RR = risk rating
TAF = thousand acre-feet
TCID = Truckee Canal Irrigation District

Alternative 350.a

Components and Features

Safety

HDPE Cutoff Wall Plus Other Structural Improvements Actions included to provide for safe operations of the Truckee Canal under this alternative are identical to the actions described for Alternative 600, and include the HDPE cutoff wall installed along approximately 17 miles of the canal embankment; replacement of turnout pipes, stockwater lines, and check structures; installation of check structures, wasteway turnout structures, and cross-drainages; increases in canal bank height; and removal of up to 115 trees.

Water Supply

Additional actions may not be necessary to ensure Project demand will be met and water rights will be served at the Desired Reliability level into the future.

Cost Estimates

The total annual cost for Alternative 350.a is $2.9 million.[1] Table 5-4 identifies estimates for non-contract costs; and total construction, capital, and annualized costs.

[1] This cost does not reflect a potential reduction that may result from TCID's 2012 activities to replace turnout structures on the Truckee Canal. Replacement of these structures likely satisfies a portion of the actions to achieve the safety objective and could reduce the field cost by $1.7 million, which is not reflected here.

Table 5-4. Alternative 350.a Cost Summary

Measure Selected for Meeting the Safety Objective	Additional Measure(s) Selected for Meeting the Water Supply Objective	Estimated Cost ($ Million)
HDPE Cutoff Wall		$44.0
	no additional measures selected	-
TOTAL FIELD COST		**$44.0**
Non-Contract Costs		
Planning and Environmental Compliance[1]		$4.40
Engineering and Design[2]		$4.40
Construction Management[3]		$4.40
Easements[4]		$0.45
Cultural Resources[5]		$1.35
TOTAL CONSTRUCTION COST		**$59.0**
Interest During Construction[6]		$2.00
TOTAL CAPITAL COST		**$61.0**
Interest and Amortization[7]		$2.80
Annual Operations and Maintenance[8]		$0.10
TOTAL ANNUAL COST		**$2.90**

Note:

Cost estimate is appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimate is presented in January 2012 dollars, and may have discrepancies due to rounding.

[1] 10 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs.

[2] 10 percent of the field cost was estimated for Engineering and Design non-contract costs.

[3] 10 percent of the field cost was estimated for Construction Management non-contract costs.

[4] 1 percent of the field cost was estimated for Easements non-contract costs.

[5] 3 percent of the field cost was estimated for Cultural Resources non-contract costs.

[6] Interest During Construction was estimated over 2 years of construction at the current Federal discount rate of 4 percent.

[7] Interest and Amortization of the capital cost was estimated over 50 years at the current Federal discount rate of 4 percent.

[8] Annual Operations and Maintenance costs were estimated at 0.2 percent of the field cost.

Key:

$ million = million dollars

HDPE = high-density polyethylene

Accomplishments

Safety

Alternative 350.a and all other alternatives formulated and selected by the Study meet the RR3 level of risk reduction required to achieve the Study's safety objective.

Water Supply

Alternative 350.a meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (95.6 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure 5-6, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-8,000 acre-feet, which is below the desired negative-10,000 acre-foot threshold.

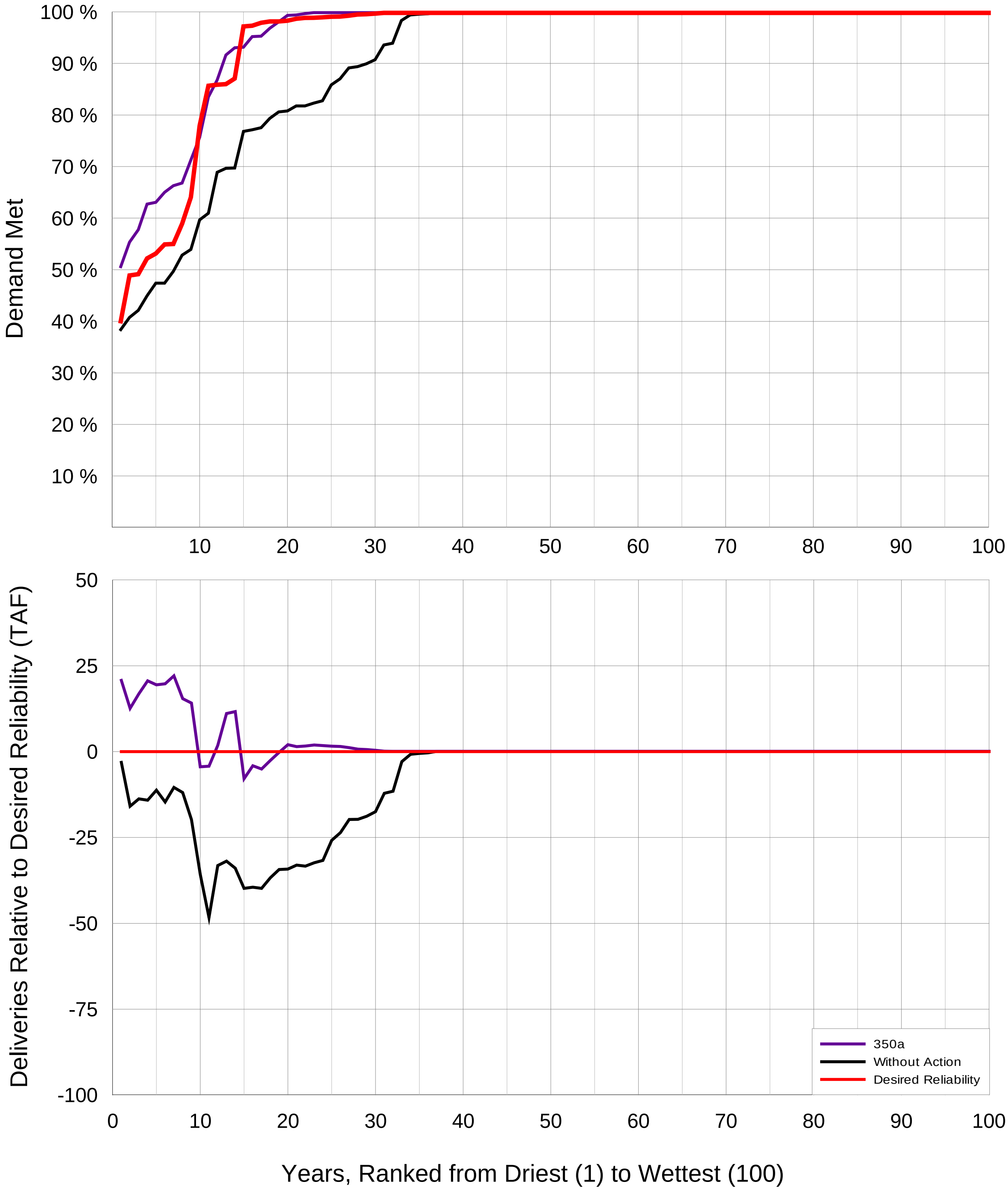


Figure 5-6. Water Supply Performance of Alternative 350.a

Project Efficiency

Alternative 350.a plans for a Project efficiency of 65 percent, and includes no actions to increase efficiency.

Seepage losses from the Truckee Canal are not reduced under this alternative.

Water Quantity and Quality on Lower Truckee River

The average annual volume of water in the lower Truckee River does not differ greatly between the Desired Reliability condition and Alternative 350.a.

- **Relative to the Desired Reliability** – Increase in Truckee River flow of 17,000 acre-feet annually.

- **Relative to the Without-Action Alternative condition** – Decrease in Truckee River flow of 29,000 acre-feet annually.

Hydropower Generation

Hydropower generation is increased under Alternative 350.a relative to the Without-Action Alternative. Average generation at Lahontan Powerplant and 26-Foot Drop powerplant is 15,650 MWh and 4,859 MWh annually, respectively.

Preliminary Alternative Review

Environmental outcomes and regulatory requirements would be very similar to those under the 600 cfs alternative, when compared to the Without-Action Alternative. The canal would be operated at a greater level than under the Without-Action Alternative, but at a lower level than under Alternative 600. Therefore, compared to the Without-Action Alternative, Lahontan Reservoir inflows and Carson River flows would increase, and Truckee River flows and Pyramid Lake inflows would decrease, but to a lesser extent than under Alternative 600. Construction activities related to safety measures would be identical to those under the 600 cfs alternative.

Environmental Outcomes

Alternative 350.a's outcomes for species and habitat in the study areas would be similar to those for Alternative 600, when compared to the Without-Action Alternative: species that use the Lahontan Reservoir and Carson Lake would experience increases in water quality and quantity; wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may increase in extent; species in the Truckee River and Pyramid Lake would experience decreases in water quantity and quality; and wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake may decrease in extent (Reclamation 2000).

Deliveries to Lahontan Reservoir and the Carson Division would increase as compared to the Without-Action Alternative. This increased water availability and return flows from agricultural users would benefit Stillwater NWR, similar to under Alternative 600, when compared to the Without-action alternative. No substantial changes in land use or land cover are anticipated to occur under this scenario; therefore, no substantial changes in air quality from agricultural activities or changes in the extent of fallow land are expected to occur.

Outcomes for the City of Fernley's municipal supply, which relies on seepage from the Truckee Canal to replenish the local groundwater aquifer, would be similar to those of Alternative 600 when compared to the Without-Action Alternative; studies have estimated that a minimum flow of 350 cfs is needed in the Truckee Canal to recharge the aquifer that served as the city's municipal water use, although this is not a valid Project delivery (City of Fernley 2012).

Construction effects from the Truckee Canal safety improvements would be identical to those noted for Alternative 600: construction activities could affect water quality and there is potential for construction noise to disturb nearby residents in some places.

Regulatory Review

A list of Federal, State, and local regulations that may be applicable is summarized in Table 5-1.

Federal Requirements Federal requirements for permitting and consultation are identical to those for Alternative 600: informal consultation with the USFWS and USACE would take place, though no permitting requirements are anticipated at this time; consultation with the Pyramid Lake Paiute and Fallon Paiute Shoshone tribes would be required related to Indian Trust Assets; and consultation with the Nevada SHPO would be required to assess any potential negative effects on NRHP-listed project features. NEPA compliance would be necessary, but potential project effects may be able to be adequately addressed with an EA.

State and Local Requirements State and local requirements for consultation and permitting are identical to those for Alternative 600, potentially including a Surface Area Disturbance Permit from NDEP, Bureau of Air Pollution, and encroachment permits from Lyon, Storey, or Churchill counties.

Economics

TCID Ability to Pay

Under Alternative 350.a, TCID's ability to pay is estimated at $6.90 million annually. This is an improvement over the Without-Action Alternative of about $1.90 million.

Preliminary Benefits

All preliminary benefits for Alternative 350.a are estimated in relation to conditions under the Without-Action Alternative. Although not quantified in the Study, safety to the City of Fernley is a primary benefit of Alternative 350.a. Benefits to agricultural, wetlands and M&I water supplies factor in the average water supply reliability of 95.6 percent that occurs under Alternative 350.a. Average annual revenue from hydropower generation increases $0.14 million over the Without-Action Alternative. The annual benefit of increased agricultural water supply for the Project is estimated at $1.00 million. The annual benefit of increased supply to wetlands is $0.41 million. The annual benefit of increased M&I supply is estimated at $0.01 million.

Implementation Considerations

Compatibility with Applicable Laws, Policies, and Plans

Alternative 350.a is anticipated to be compatible with all existing laws and policies. It is also compatible with recent Truckee Canal rehabilitation actions taken by TCID to remove the 33 existing conduits to the laterals and replace them with 17 structures that include both lateral and stock line delivery features (TCID 2012b).

The range of environmental outcomes is more limited under this alternative than other alternatives evaluated, and may be able to be evaluated in an EA (see the “Preliminary Alternative Review” subsection above).

Federal and Non-Federal Roles and Responsibilities

Reclamation would likely be the Federal lead for permitting and NEPA compliance. As the local contractor, TCID would likely obtain State and local permits related to construction activities.

Potential for Cost-Sharing

TCID TCID should be considered a potential cost-share partner because Alternative 350.a significantly increases the water supply reliability experienced by its customers, which in turn improves its hydropower generation capacity—one of the largest sources of annual revenue for the district.

City of Fernley The City of Fernley should be considered as a potential cost-share partner for this Study alternative. The benefit of life safety and averted flood damage reduction would serve as a portion of the benefit that the city derives from Alternative 350.a. Additionally, Fernley receives the incidental benefit of continued seepage from the Truckee Canal into the local aquifer. By implementing this alternative, instead of another alternative that lines the Truckee Canal and reduces seepage, the city avoids the cost of replacing the groundwater supplies that they rely on.

Summary of Alternative 350.a

Table 5-5 below summarizes the performance, accomplishments, benefits, costs, and other characteristics of Alternative 350.a.

Table 5-5. Characteristics of Alternative 350.a

		Alternative 350.a	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	350 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	HDPE Cutoff Wall	-	NA
	Other Features	-	-	NA
Safety		Meets RR3	Uncertain[11]	NA
Average Annual Project Water Delivery[1] (percent)		95.6%	90.5%	94.6%
Average Annual Project Delivery by User Category	Ag/Irrigation (TAF)	117.2	111.2	NA
	Deliveries to M&I (TAF)	13.3	13.2	NA
	Lahontan Valley Wetlands[2] (TAF)	67.3	63.6	NA
Annual Cost[3] (millions)		$2.90	NA	NA
TCID Ability-to-Pay[12] (millions)		$6.90	$5.00	NA[9]
Preliminary Benefits[5] (annual)	Agricultural Water Supply Reliability (millions)	$1.00	NA	NA
	Wetlands/ Environmental Water Supply Reliability[4] (millions)	$0.41	NA	NA
	M&I Water Supply Reliability (millions)	$0.01	NA	NA
	Hydropower Generation Revenue (millions)	$0.14	NA	NA
	Safety[6]	Increased	NA	NA
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[7]	12.1	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[10]	Significant change not anticipated	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[8] (percent)	108%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	487	516	460[13]

Table 5-5. Characteristics of Alternative 350.a (contd.)

Notes:

[1] Long-term average annual percent of Newlands Project demand met.

[2] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[3] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[4] Based on volume of deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR, and also spills to Stillwater from Lahontan Dam. Excludes consideration of water supply from return flows and groundwater.

[5] Preliminary benefits were estimated as the change between a Study alternative and the Without-Action Alternative for agricultural water supply, wetlands water supply, M&I water supply, and hydropower generation revenue. Water supply reliability under each Study alternative is factored into that alternative's benefits calculation. Benefits reported are annual, estimated over 50 years at the current Federal discount rate of 4 percent. For additional information, see appendixes D8, G1, and G2.

[6] The benefits of improved safety have not been quantified for this Study, but would need to be more fully evaluated for a feasibility study or for cost-allocation purposes.

[7] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[8] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[9] Assessment of financial conditions was not conducted for the Desired Reliability scenario, because this scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

[10] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[11] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the safety objective (RR3) is unknown.

[12] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[13] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:

Avg. = average

cfs = cubic feet per second

M&I = municipal and industrial

NWR = National Wildlife Refuge

RR = risk rating

TAF = thousand acre-feet

TCID = Truckee Canal Irrigation District

Alternative 350.b

Components and Features

Safety

HDPE Cutoff Wall Plus Other Structural Improvements Actions included to provide for safe operations of the Truckee Canal under this alternative are identical to the actions described for alternatives 600 and 350.a, and include the HDPE cutoff wall installed along approximately 17 miles of the canal embankment; replacement of turnout pipes, stockwater lines, and check structures; installation of check structures, wasteway turnout structures, and cross-drainages; increases in canal bank height; and removal of up to 115 trees.

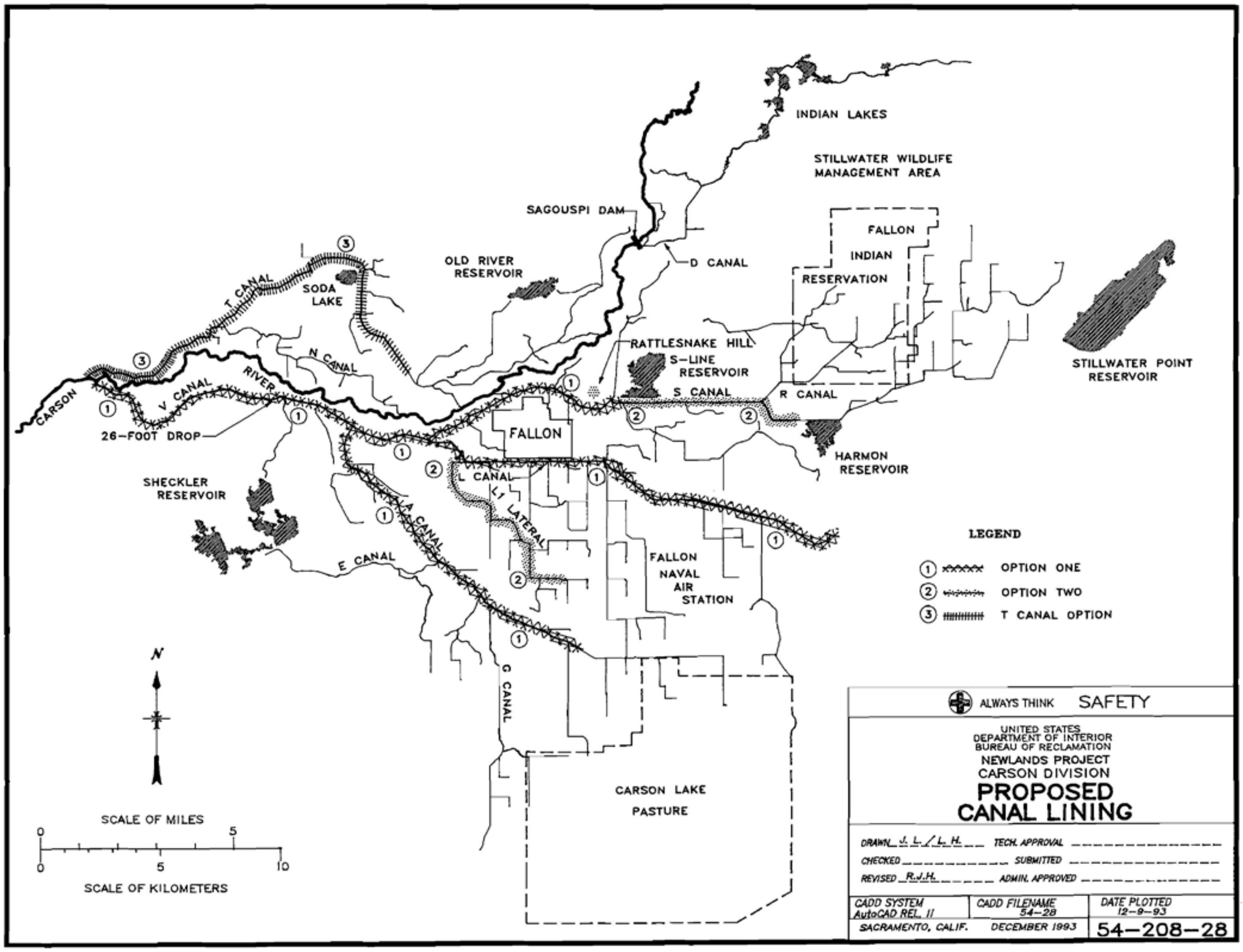
Water Supply

Line Carson Division's Main Canals and Laterals Line 44.9 miles of conveyance facilities in the Carson Division with a 4-inch concrete geomembrane liner, consistent with the "Option 1 Expanded" recommendation in the *Newlands Project Efficiency Study* (Reclamation 1994). This includes portions of the V, S, L, and A canals, and part of the L1 Lateral—facilities in which conveyance losses due to seepage are greatest, based on conclusions of the Efficiency Study.

Areas to be lined include:

- V Canal from its head works to 26-Foot Drop (first 5.9 miles)
- V Canal from 26-Foot drop to terminus, and S Canal from V Canal terminus to S-line Reservoir (9.33 miles)
- L Canal from its headworks at V Canal to its terminus at the sixth and final check structure (first 9.37 miles)
- A Canal from its headworks to the A17 Lateral headworks (first 9.7 miles)
- S Canal between S-line Reservoir and Harmon Reservoir (5.07 miles)
- Unlined portion of L1 Lateral from the headworks to the L1-10 Lateral (5.5 miles of the first 6 miles)

The extent lining is shown as "Option 1" and "Option 2," in combination, on Figure 5-7 below from the Efficiency Study.



Source: Reclamation 1994

Figure 5-7. Carson Division Canal Lining Options

Cost Estimates

The total annual cost for Alternative 350.b is $15 million.[1] The following table identifies estimates for non-contract costs; and total construction, capital, and annualized costs.

[1] This cost does not reflect a potential reduction that may result from TCID's 2012 activities to replace turnout structures on the Truckee Canal. Replacement of these structures likely satisfies a portion of the actions to achieve the safety objective and could reduce the field cost by $1.7 million, which is not reflected here.

Table 5-6. Alternative 350.b Cost Summary

Measure Selected for Meeting the Safety Objective	Additional Measure(s) Selected for Meeting the Water Supply Objective	Estimated Cost ($ Million)
HDPE Cutoff Wall		$44.0
	Line Main Canals and Laterals	$165.0
TOTAL FIELD COST		**$210.0**
Non-Contract Costs		
Planning and Environmental Compliance[1]		$10.0
Engineering and Design[2]		$21.0
Construction Management[3]		$21.0
Easements[4]		$2.00
Cultural Resources[5]		$6.00
TOTAL CONSTRUCTION COST		**$270.0**
Interest During Construction[6]		$50.0
TOTAL CAPITAL COST		**$320.0**
Interest and Amortization[7]		$14.5
Annual Operations and Maintenance[8]		$0.50
TOTAL ANNUAL COST		**$15.0**

Note:
Cost estimate is appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimate is presented in January 2012 dollars, and may have discrepancies due to rounding.

[1] 5 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs.

[2] 10 percent of the field cost was estimated for Engineering and Design non-contract costs.

[3] 10 percent of the field cost was estimated for Construction Management non-contract costs.

[4] 1 percent of the field cost was estimated for Easements non-contract costs.

[5] 3 percent of the field cost was estimated for Cultural Resources non-contract costs.

[6] Interest During Construction was estimated over 8 years of construction at the current Federal discount rate of 4 percent.

[7] Interest and Amortization of the capital cost was estimated over 50 years at the current Federal discount rate of 4 percent.

[8] Annual Operations and Maintenance costs were estimated at 0.2 percent of the field cost.

Key:
$ million = million dollars
HDPE = high-density polyethylene

Accomplishments

Safety

Alternative 350.b and all other alternatives formulated and selected by the Study meet the RR3 level of risk reduction required to achieve the Study's safety objective.

Water Supply

Alternative 350.b meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (97.3 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure 5-8, deliveries for Alternative 350.b exceed those for the Desired Reliability for each of the 100 years evaluated.

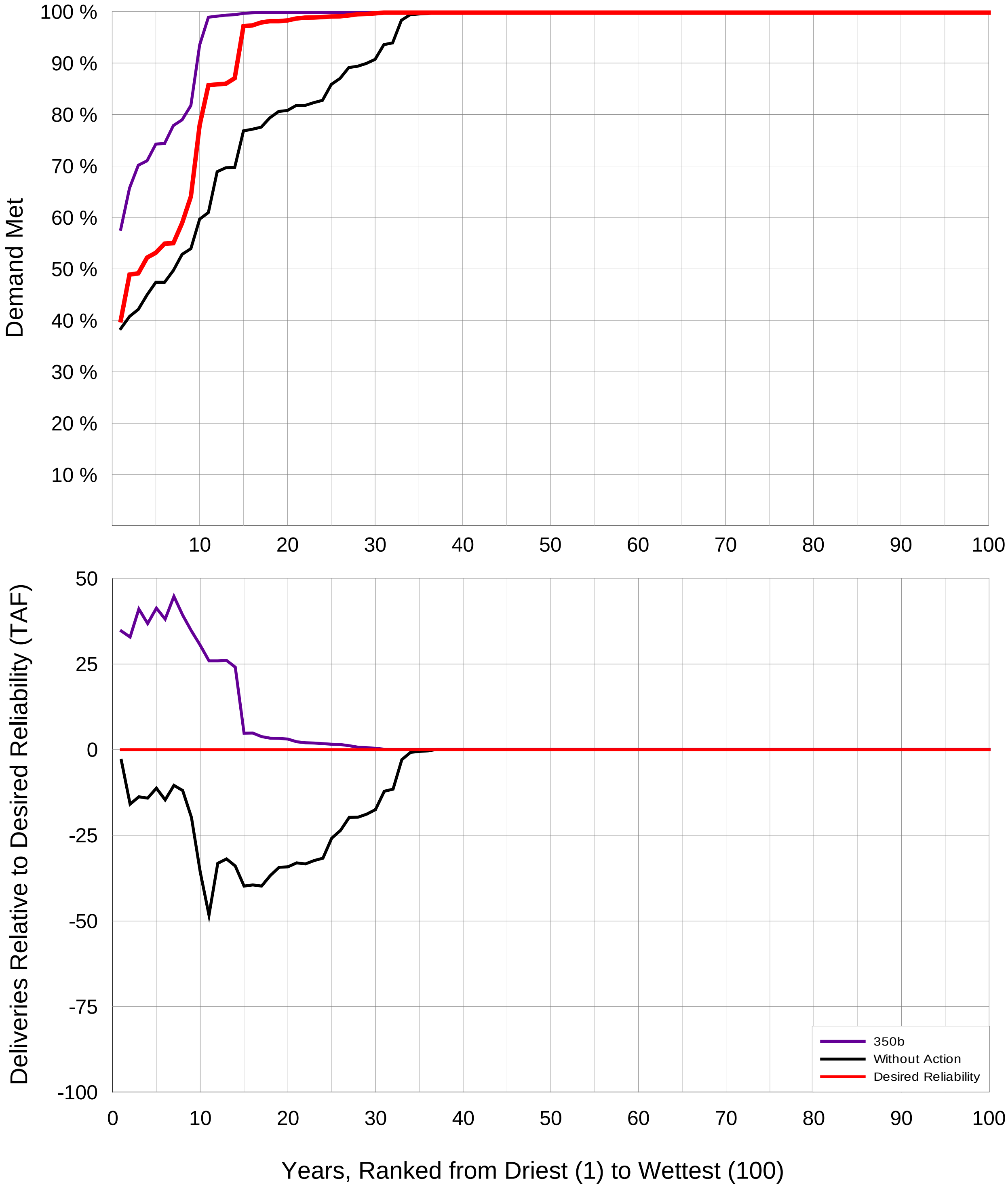


Figure 5-8. Water Supply Performance of Alternative 350.b

Project Efficiency

Alternative 350.b plans for increasing Project efficiency to 75 percent, with the associated increases in water supply being dedicated to Project water users.

Seepage losses from the Truckee Canal are not reduced under this alternative.

Water Quantity and Quality on Lower Truckee River

The average annual volume of water in the lower Truckee River for Alternative 350.b is greater than that of the Desired Reliability condition but less than that of the Without-Action Alternative.

- **Relative to the Desired Reliability** – Increase in Truckee River flow of 35,000 acre-feet annually.

- **Relative to the Without-Action Alternative condition –** Decrease in Truckee River flow of 11,000 acre-feet annually.

Hydropower Generation

Hydropower generation is increased under Alternative 350.b relative to the Without-Action Alternative. Average generation at Lahontan Powerplant and 26-Foot Drop powerplant is 15,179 MWh and 4,331 MWh annually, respectively.

Preliminary Alternative Review

Environmental outcomes and regulatory requirements would be somewhat similar to those under Alternative 350.a, when compared to the Without-Action Alternative. Alternative 350.b would have an overall lower level of water diversion than 350.a. Alternative 350.b would have same construction effects as alternatives 600 cfs and 350.a, with the addition of effects from lining of canals in the Carson Division. There would be direct effects from construction activities in the canals and indirect effects related to potential reductions in groundwater levels throughout the Carson Division.

Environmental Outcomes

Alternative 350.b's outcomes for species and habitat in the study areas would be similar to those for alternatives 600 and 350.a, when compared to the Without-Action Alternative: species that use the Lahontan Reservoir and Carson Lake would experience increases in water quality and quantity; wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may increase in extent; species in the Truckee River and Pyramid Lake would experience decreases in water quantity and quality; and wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake may decrease in extent (Reclamation 2000).

Deliveries to Lahontan Reservoir and the Carson Division would increase as compared to the Without-Action Alternative. Increased water availability within the Carson Division and return flows from agricultural users would benefit

Stillwater NWR, similar to under alternatives 600 and 350.a, when compared to the Without-action alternative.

This could be offset, however, by a reduction in seepage noted above from the main canals and laterals in the Carson Division, which could affect the reliability of local groundwater supplies for the City of Fallon, Churchill County, and NAS Fallon (Brad Goetsch and Eleanor Lockwood, Churchill County, personal communication, August 25, 2011). No permanent changes in land use or land cover are anticipated to occur under this scenario; therefore, no substantial changes in air quality from agricultural activities or changes in the extent of fallow land are expected to occur.

Additionally, it is possible that with a reduction in groundwater, some Project landowners may seek to have their land reclassified from bottom land to bench land (public comments, August 2011). A large portion of the Carson Division has been classified as bottom land due to the shallow depths to groundwater, which is supported by land application in the Project and by seepage losses during conveyance. The duty for bottom lands is set at 3.5 acre-feet per acre, with the assumption that a portion of crop demands is met from groundwater within the root-zone. If groundwater levels recede, portions of the Carson Division may need to be reclassified as bench lands, with a corresponding increase in duty for those lands to 4.5 acre-feet per acre. Rights would need to be reclassified individually, with review and approval from the Nevada State Engineer and/or Federal Watermaster. However, this Study has noted that even if a large proportion of Project lands were to be reclassified, the overall effect on Project demand would be an increase of about 2 percent (see Appendix D4).

Outcomes for the City of Fernley's municipal supply, which relies on seepage from the Truckee Canal to replenish the local groundwater aquifer, would be similar to those of alternatives 600 and 350.a when compared to the Without-Action Alternative; studies have estimated that a minimum flow of 350 cfs is needed in the Truckee Canal to recharge the aquifer that served as the city's municipal water use, although this is not a valid Project delivery (City of Fernley 2012).

Construction effects from the Truckee Canal safety improvements would be identical to those noted for alternatives 600 and 350.a: construction activities could affect water quality and there is potential for construction noise to disturb nearby residents in some places. Construction activities associated with canal lining in the Carson Division would result in similar effects to those related to the Truckee Canal, but in a larger geographic area; therefore, construction effects would be similar to those under alternatives 600 cfs and 350.a, but more extensive.

Regulatory Review

A list of Federal, State, and local regulations that may be applicable is summarized in Table 5-1.

Federal Requirements Federal requirements for permitting and consultation are similar to those for alternatives 600 and 350.a: informal consultation with the USFWS and USACE would take place, though no permitting requirements are anticipated at this time; consultation with the Pyramid Lake Paiute and Fallon Paiute Shoshone tribes would be required related to Indian Trust Assets; and consultation with the Nevada SHPO would be required to assess any potential negative effects on NRHP-listed project features. However, because of the range and complexity of potential environmental outcomes of Alternative 350.b, an EIS – rather than an EA – may be required to sufficiently evaluate effects.

State and Local Requirements State and local requirements for consultation and permitting are likely identical to those for alternatives 600 and 350.a, potentially including: a Surface Area Disturbance Permit from NDEP, Bureau of Air Pollution, and encroachment permits from Lyon, Storey, or Churchill counties.

Economics

TCID Ability to Pay

Under Alternative 350.b, TCID's ability to pay is estimated at $7.40 million annually. This is an improvement over the Without-Action Alternative of about $2.40 million.

Preliminary Benefits

All preliminary benefits for Alternative 350.b are estimated in relation to conditions under the Without-Action Alternative. Although not quantified in the Study, safety to the City of Fernley is a primary benefit of Alternative 350.b. Benefits to agricultural, wetlands and M&I water supplies factor in the average water supply reliability of 97.3 percent that occurs under Alternative 350.b. Average annual revenue from hydropower generation increases $0.08 million over the Without-Action Alternative. The annual benefit of increased agricultural water supply for the Project is estimated at $1.35 million. The annual benefit of increased supply to wetlands is $0.70 million. The annual benefit of increased M&I supply is estimated at $0.02 million.

Implementation Considerations

Compatibility with Applicable Laws, Policies, and Plans

Alternative 350.b is anticipated to be compatible with all existing laws and policies. It is also compatible with recent Truckee Canal rehabilitation actions taken by TCID to remove the 33 existing conduits to the laterals and replace them with 17 structures that include both lateral and stock line delivery features (TCID 2012b).

It is possible that the actions in alternative 350.b may require a more extensive NEPA evaluation before implementation (see the “Preliminary Alternative Review” subsection above), such as an EIS rather than an EA.

Federal and Non-Federal Roles and Responsibilities

Reclamation would likely be the Federal lead for permitting and NEPA compliance. As the local contractor, TCID would likely obtain State and local permits related to construction activities.

Potential for Cost-Sharing

TCID TCID should be considered a potential cost-share partner because Alternative 350.b significantly increases the water supply reliability experienced by its customers, which in turn improves its hydropower generation capacity—one of the largest sources of annual revenue for the district.

City of Fernley The City of Fernley should be considered as a potential cost-share partner for this Study alternative. The benefit of life safety and averted flood damage reduction would serve as a portion of the benefit that the city derives from Alternative 350.b. Additionally, Fernley receives the incidental benefit of continued seepage from the Truckee Canal into the local aquifer. By implementing this alternative, instead of another alternative that lines the Truckee Canal and reduces seepage, the city avoids the cost of replacing the groundwater supplies that they rely on.

Pyramid Lake Paiute Tribe The Pyramid Lake Paiute Tribe should be considered as a potential cost-share partner. Among the range of alternatives available for meeting the Study objectives, Alternative 350.b maintains the second-highest flows to Pyramid Lake.

Summary of Alternative 350.b

Table 5-7 below summarizes the performance, accomplishments, benefits, costs, and other characteristics of Alternative 350.b.

Table 5-7. Characteristics of Alternative 350.b

		Alternative 350.b	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	350 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	HDPE Cutoff Wall	-	NA
	Other Features	Lining 45 miles of Carson Division canals	-	NA
Safety		Meets RR3	Uncertain[12]	NA
Average Annual Project Water Delivery[1] (percent)		97.3%	90.5%	94.6%
Average Annual Project Delivery by User Category	Ag/Irrigation (TAF)	119.2	111.2	NA
	M&I (TAF)	13.4	13.2	NA
	Lahontan Valley Wetlands[2] (TAF)	68.6	63.6	NA
Annual Cost[3] (millions)		$15.00	NA	NA
TCID Ability-to-Pay[13] (millions)		$7.40	$0.72	NA[10]
Preliminary Benefits[6] (annual)	Agricultural Water Supply Reliability (millions)	$1.35	NA	NA
	Wetlands/ Environmental Water Supply Reliability[4] (millions)	$0.70[5]	NA	NA
	M&I Water Supply Reliability (millions)	$0.02	NA	NA
	Hydropower Generation Revenue (millions)	$0.08	NA	NA
	Safety[7]	Increased	NA	NA
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[8]	14.3	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[11]	Reduced by lining Carson Division canals	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[9] (percent)	108%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	505	516	460[14]

Table 5-7. Characteristics of Alternative 350.b (contd.)

Notes:

[1] Long-term average annual percent of Newlands Project demand met.

[2] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[3] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[4] Based on volume of deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR, and also spills to Stillwater from Lahontan Dam. Excludes consideration of water supply from return flows and groundwater.

[5] May be lower due to reductions in other supply sources resulting from implementation of Study alternatives, but which could not be quantified.

[6] Preliminary benefits were estimated as the change between a Study alternative and the Without-Action Alternative for agricultural water supply, wetlands water supply, M&I water supply, and hydropower generation revenue. Water supply reliability under each Study alternative is factored into that alternative's benefits calculation. Benefits reported are annual, estimated over 50 years at the current Federal discount rate of 4 percent. For additional information, see appendixes D8, G1, and G2.

[7] The benefits of improved safety have not been quantified for this Study, but would need to be more fully evaluated for a feasibility study or for cost-allocation purposes.

[8] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[9] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[10] Assessment of financial conditions was not conducted for the Desired Reliability scenario, because this scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

[11] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[12] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the safety objective (RR3) is unknown.

[13] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[14] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:

Avg. = average

M&I = municipal and industrial

RR = risk rating

TAF = thousand acre-feet

TCID = Truckee Canal Irrigation District

Alternative 350.d

Components and Features

Safety

Concrete Geomembrane Lining The primary action to achieve safety is to line the Truckee Canal in the following portions of the structure:

- 1.7 miles of the Derby Reach of the canal (between STA 409+75 to 411+00, 418+00 to 425+00, 433+00 to 445+00, 469+00 to 502+00, and 525+00 to 543+10)
- The entire Fernley Reach (from STA 543+10 to 1126+40)
- 4.2 miles of the Lahontan Reach (from STA 1126+40 to 1260+00, 1270+00 to 1288+00, 1294+00 to 1300+00, and 1302+00 to 1340+00)

This option consists of constructing an unreinforced concrete lining on top of a Low-Density Polyethylene (LDPE) geomembrane. The canal section would be designed to a smaller cross-section prism than the existing channel geometry. Because of concerns with the stability of the unreinforced concrete being placed on top of the membrane, a side slope of 2 horizontal to 1 vertical (2:1) would be the maximum side slopes. The LDPE geomembrane will be textured creating additional friction between the membrane and concrete lining. The LDPE would need to be 40 thousandth of an inch (mil) thick. The unreinforced concrete lining would be 3 inches thick. The concrete lining protects the LDPE from being damaged during maintenance work, large debris flows, and animals.

The installation of a properly installed geomembrane and concrete liner would essentially eliminate seepage into the canal embankment and foundation.

Other Structural Improvements Additional actions to achieve the safety objective for this alternative:

- Replace each turnout pipe in the canal: nine in the Fernley Reach (at STA 578+66, 641+09, 668+58, 695+60, 728+50, 822+13, 848+82, 1003+54, and 1057+84) and two in the Lahontan Reach (at 1302+39 and 1465+06). The turnouts would be designed with the appropriate canal water surface elevation for delivering the required turnout flows. A new turnout structure with slide gate will be installed with the required pipe diameters designed to deliver the flow needed. A sand filter collar would be installed along a portion of the outlet side of the pipe. Riprap protection within the canal bank on either side of the structure would prevent animals from burrowing around the structure.[1]

- Replace all stock water line systems, and combine existing stock watering pipes with the new turnouts where applicable.[1]
- Replace four check structures in the Fernley Reach (Fernley, Anderson, and Allendale checks) and Lahontan Reach (Mason Check) with new, automated check structures.
- Remove the abandoned Pyramid (Derby) Check.
- Install a new check structure upstream from TC-1.
- Install five cross-drainage structures in the Derby Reach (at STA 28+00, 93+00, 180+00, 266+65, and 464+50).
- Install 10 wasteway turnout structures in the Fernley Reach (STA 544+33, 589+53, 633+70, 684+00, 795+15, 850+14, 923+58, 973+70, 1050+40, and 1100+00).
- Increase the canal bank height along 1.9 miles of the Lahontan Reach (from STA 1200+00 to 1302+00).
- Remove up to 115 trees located within 15 feet of the downstream toe of the landside slope in the Fernley and Lahontan reaches.

Replacing existing canal appurtenance structures and new canal appurtenance structures provides risk reduction for several Truckee Canal failure modes (see Chapter 3). The cross-drainage structures will convey rainfall runoff across the canal and into the Truckee River in the Derby Reach. The new check structures will replace the existing checks to provide large check openings and gates to pass ice-jammed flows and flood flows. They will also allow for elevated water levels above the normal operating level to bypass the check gates by overflowing weirs on either side of the gates. The wasteway turnout structures combine an overflow weir and turnout into one structure that provides protection against overtopping of the canal, as well as normal diversion delivery flow to irrigators.

[1] These actions were identified by Reclamation in the Corrective Action Study (Reclamation 2011e) before TCID replaced the Truckee Canal’s turnouts with new structures that include both stock line and delivery features. This canal conduit rehabilitation work occurred in 2012 and likely satisfies a portion of the safety objective the alternatives seek to achieve.

Water Supply

Line Truckee Canal As described for safety purposes above, line approximately 17 miles of the Truckee Canal with an impermeable geomembrane covered by unreinforced concrete.

Cost Estimates

The total annual cost for Alternative 350.d is $4.2 million.[1] Table 5-8 identifies estimates for non-contract costs; and total construction, capital, and annualized costs.

[1] This cost does not reflect a potential reduction that may result from TCID's 2012 activities to replace turnout structures on the Truckee Canal. Replacement of these structures likely satisfies a portion of the actions to achieve the safety objective and could reduce the field cost by $1.7 million, which is not reflected here.

Table 5-8. Alternative 350.d Cost Summary

Measure Selected for Meeting the Safety Objective	Additional Measure(s) Selected for Meeting the Water Supply Objective	Estimated Cost ($ Million)
Concrete/ Geomembrane Lining		$59.0
	No additional measures selected	-
TOTAL FIELD COST		**$59.0**
Non-Contract Costs		
Planning and Environmental Compliance[1]		$7.00
Engineering and Design[2]		$5.80
Construction Management[3]		$5.80
Easements[4]		$0.60
Cultural Resources[5]		$1.80
TOTAL CONSTRUCTION COST		**$80.0**
Interest During Construction[6]		$7.00
TOTAL CAPITAL COST		**$87.0**
Interest and Amortization[7]		$4.10
Annual Operations and Maintenance[8]		$0.10
TOTAL ANNUAL COST		**$4.20**

Note:

Cost estimate is appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimate is presented in January 2012 dollars, and may have discrepancies due to rounding.

[1] 12 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs.

[2] 10 percent of the field cost was estimated for Engineering and Design non-contract costs.

[3] 10 percent of the field cost was estimated for Construction Management non-contract costs.

[4] 1 percent of the field cost was estimated for Easements non-contract costs.

[5] 3 percent of the field cost was estimated for Cultural Resources non-contract costs.

[6] Interest During Construction was estimated over 4 years of construction at the current Federal discount rate of 4 percent.

[7] Interest and Amortization of the capital cost was estimated over 50 years at the current Federal discount rate of 4 percent.

[8] Annual Operations and Maintenance costs were estimated at 0.2 percent of the field cost.

Key:

$ million = million dollars

HDPE = high-density polyethylene

Accomplishments

Safety

Alternative 350.d and all other alternatives formulated and selected by the Study meet the RR3 level of risk reduction required to achieve the Study's safety objective.

Water Supply

Alternative 350.d meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (96.3 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure 5-9, deliveries for Alternative 350.d exceed those for the Desired Reliability for each of the 100 years evaluated.

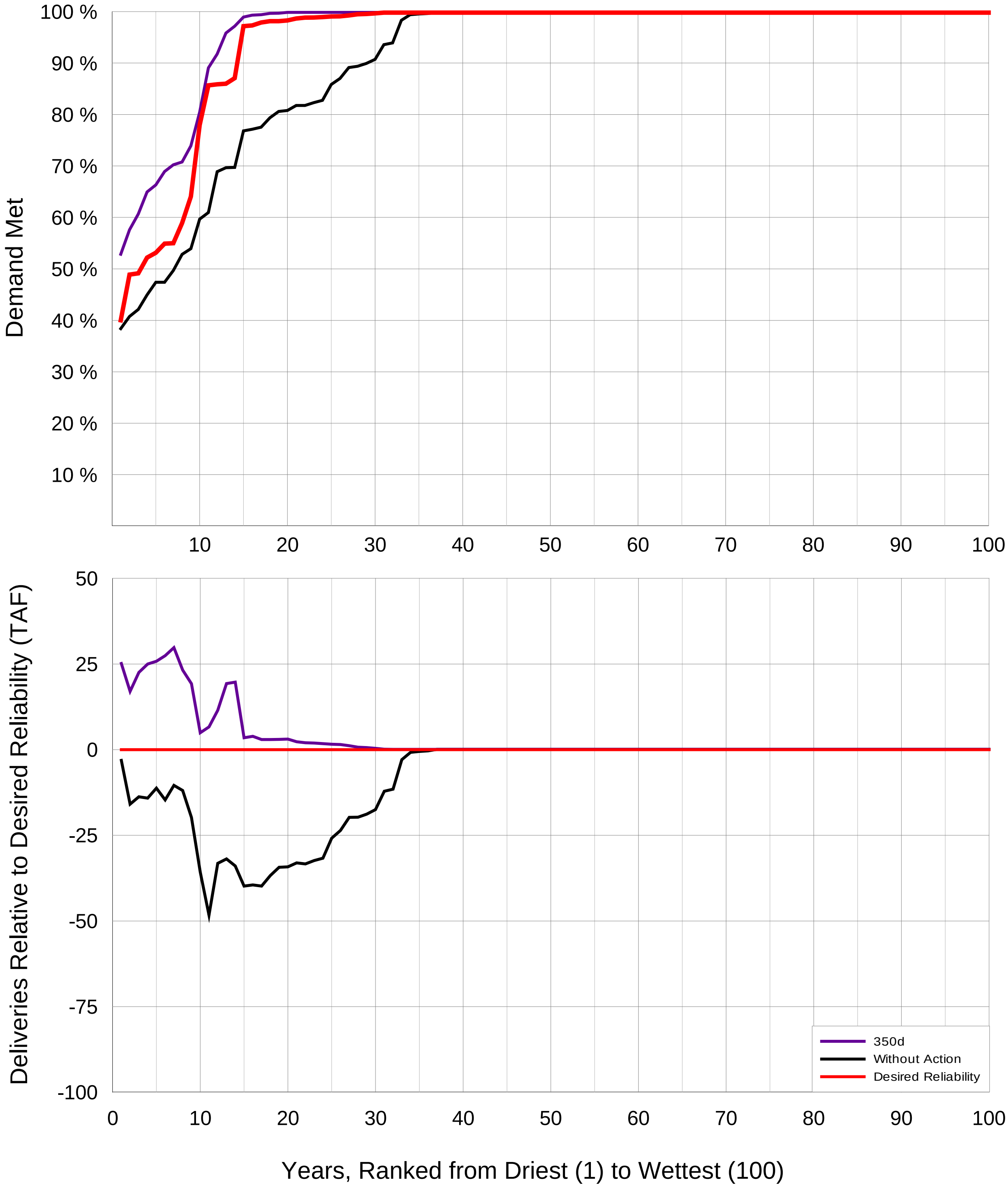


Figure 5-9. Water Supply Performance of Alternative 350.d

Project Efficiency

Alternative 350.d plans for a Project efficiency of 65 percent, and includes no actions to increase efficiency.

Seepage losses from the Truckee Canal are reduced by approximately 85 percent under this alternative.

Water Quantity and Quality on Lower Truckee River

The average annual volume of water in the lower Truckee River for Alternative 350.d is greater than that of the Desired Reliability condition but less than that of the Without-Action Alternative.

- **Relative to the Desired Reliability –** Increase in Truckee River flow of 21,000 acre-feet annually.

- **Relative to the Without-Action Alternative condition –** Decrease in Truckee River flow of 25,000 acre-feet annually.

Hydropower Generation

Hydropower generation is increased under Alternative 350.d relative to the Without-Action Alternative. Average generation at Lahontan Powerplant and 26-Foot Drop powerplant is 16,020 MWh and 4,909 MWh annually, respectively.

Preliminary Alternative Review

Environmental outcomes and regulatory requirements would be somewhat similar to those under Alternative 350.a, when compared to the Without-Action Alternative. This alternative would have a similar level of water diversion as Alternative 350.a, and similar construction effects on the Truckee Canal as alternatives 600, 350.a, and 350.b, except that concrete and geomembrane lining would be installed rather than an HDPE cutoff wall. This would result in substantially less canal seepage, which would reduce the groundwater contributions in the Truckee Division.

Environmental Outcomes

Alternative 350.d’s outcomes for species and habitat in the study areas would be similar to those for alternatives 600, 350.a, and 350.b when compared to the Without-Action Alternative: species that use the Lahontan Reservoir and Carson Lake would experience increases in water quality and quantity; wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may increase in extent; species in the Truckee River and Pyramid Lake would experience decreases in water quantity and quality; and wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake may decrease in extent (Reclamation 2000).

Deliveries to Lahontan Reservoir and the Carson Division would increase as compared to the Without-Action Alternative. Increased availability of groundwater and return flows within the Carson Division would benefit Stillwater NWR, similar to under alternatives 600 and 350.a when compared to the Without-action alternative. No permanent changes in land use or land cover are anticipated to occur under this scenario; therefore, no substantial changes in air quality from agricultural activities or changes in the extent of fallow land are expected to occur.

The City of Fernley relies on seepage from the Truckee Canal to replenish the local aquifer, which is used for municipal and industrial water, although this is not a valid Project delivery. Alternative 350.d's concrete geomembrane lining of the Truckee Canal would eliminate seepage into the local aquifer, thus reducing Fernley's ability to meet its total municipal demand (City of Fernley 2012).

Construction effects from the Truckee Canal safety improvements would be very similar or identical to those noted for alternatives 600, 350.a, and 350.b: construction activities could affect water quality and there is potential for construction noise to disturb nearby residents in some places.

Regulatory Review

A list of Federal, State, and local regulations that may be applicable is summarized in Table 5-1.

Federal Requirements Federal requirements for permitting and consultation are likely identical to those for Alternative 350.b: informal consultation with the USFWS and USACE would take place, though no permitting requirements are anticipated at this time; consultation with the Pyramid Lake Paiute and Fallon Paiute Shoshone tribes would be required related to Indian Trust Assets; and consultation with the Nevada SHPO would be required to assess any potential negative effects on NRHP-listed project features. Because of the range and complexity of potential environmental outcomes of Alternative 350.d, an EIS – rather than an EA – may be required to sufficiently evaluate effects.

State and Local Requirements State and local requirements for consultation and permitting are likely identical to those for alternatives 600, 350.a, and 350.b, potentially including: a Surface Area Disturbance Permit from NDEP, Bureau of Air Pollution, and encroachment permits from Lyon, Storey, or Churchill counties.

Economics

TCID Ability to Pay

Under Alternative 350.d, TCID's ability to pay is estimated at $7.20 million annually. This is an improvement over the Without-Action Alternative of about $2.20 million.

Preliminary Benefits

All preliminary benefits for Alternative 350.d are estimated in relation to conditions under the Without-Action Alternative. Although not quantified in the Study, safety to the City of Fernley is a primary benefit of Alternative 350.d. Benefits to agricultural, wetlands and M&I water supplies factor in the average water supply reliability of 96.3 percent that occurs under Alternative 350.d. Average annual revenue from hydropower generation increases $0.16 million over the Without-Action Alternative. The annual benefit of increased agricultural water supply for the Project is estimated at $1.15 million. The annual benefit of increased supply to wetlands is $0.54 million. The annual benefit of increased M&I supply is estimated at $0.01 million.

Implementation Considerations

Compatibility with Applicable Laws, Policies, and Plans

Alternative 350.d is anticipated to be compatible with all existing laws and policies. It is also compatible with recent Truckee Canal rehabilitation actions taken by TCID to remove the 33 existing conduits to the laterals and replace them with 17 structures that include both lateral and stock line delivery features (TCID 2012b).

It is possible that the actions in Alternative 350.d may require a more extensive NEPA evaluation before implemention (see “Preliminary Alternative Review” subsection above), such as an EIS rather than an EA.

Federal and Non-Federal Roles and Responsibilities

Reclamation would likely be the Federal lead for permitting and NEPA compliance. As the local contractor, TCID would likely obtain State and local permits related to construction activities.

Potential for Cost-Sharing

TCID TCID should be considered a potential cost-share partner because Alternative 350.d significantly increases the water supply reliability experienced by its customers, which in turn improves its hydropower generation capacity—one of the largest sources of annual revenue for the district.

City of Fernley The City of Fernley should be considered as a potential cost-share partner for at least feasibility assessments of Study alternatives. The benefit of life safety and averted flood damage reduction would serve as a portion of the benefit that the city derives from the Study alternatives.

Summary of Alternative 350.d

Table 5-9 below summarizes the performance, accomplishments, benefits, costs, and other characteristics of Alternative 350.d.

Table 5-9. Characteristics of Alternative 350.d

		Alternative 350.d	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	350 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	Lining	-	NA
	Other Features	-	-	NA
Safety		Meets RR3	Uncertain[11]	NA
Average Annual Project Water Delivery[1] (percent)		96.3%	90.5%	94.6%
Average Annual Project Delivery by User Category	Ag/Irrigation (TAF)	118.0	111.2	NA
	M&I (TAF)	13.3	13.2	NA
	Lahontan Valley Wetlands[2] (TAF)	67.8	63.6	NA
Annual Cost[3] (millions)		$4.20	NA	NA
TCID Ability-to-Pay[12] (millions)		$7.20	$5.00	NA[9]
Preliminary Benefits[5] (annual)	Agricultural Water Supply Reliability (millions)	$1.15	NA	NA
	Wetlands/ Environmental Water Supply Reliability[4] (millions)	$0.54	NA	NA
	M&I Water Supply Reliability (millions)	$0.01	NA	NA
	Hydropower Generation Revenue (millions)	$0.16	NA	NA
	Safety[6]	Increased	NA	NA
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[7]	13.2	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[9]	Significant change not anticipated	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[8] (percent)	56%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	491	516	460[13]

Table 5-9. Characteristics of Alternative 350.d (contd.)

Notes:

[1] Long-term average annual percent of Newlands Project demand met.

[2] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[3] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[4] Based on volume of deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR, and also spills to Stillwater from Lahontan Dam. Excludes consideration of water supply from return flows and groundwater.

[5] Preliminary benefits were estimated as the change between a Study alternative and the Without-Action Alternative for agricultural water supply, wetlands water supply, M&I water supply, and hydropower generation revenue. Water supply reliability under each Study alternative is factored into that alternative's benefits calculation. Benefits reported are annual, estimated over 50 years at the current Federal discount rate of 4 percent. For additional information, see appendixes D8, G1, and G2.

[6] The benefits of improved safety have not been quantified for this Study, but would need to be more fully evaluated for a feasibility study or for cost-allocation purposes.

[7] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[8] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[9] Assessment of financial conditions was not conducted for the Desired Reliability scenario, because this scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

[10] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[11] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the safety objective (RR3) is unknown.

[12] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[13] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:

Avg. = average

cfs = cubic feet per second

M&I = municipal and industrial

NWR = National Wildlife Refuge

RR = risk rating

TAF = thousand acre-feet

TCID = Truckee Canal Irrigation District

Alternative 250.a

Components and Features

Safety

HDPE Cutoff Wall Plus Other Structural Improvements Actions included to provide for safe operations of the Truckee Canal under this alternative are identical to the actions described for alternatives 600, 350.a, and 350.b, and include the HDPE cutoff wall installed along approximately 17 miles of the canal embankment; replacement of turnout pipes, stockwater lines, and check structures; installation of check structures, wasteway turnout structures, and cross-drainages; increases in canal bank height; and removal of up to 115 trees.

Water Supply

Fallow 25 Percent of Water Rights During Dry Years Reduce demand from the Project by temporarily fallowing approximately 25 percent of water-righted Project agricultural land in dry years. Farmers who choose to forego their irrigation rights will be compensated.

Cost Estimates

The total annual cost for Alternative 250.a is $6.5 million.[1] Table 5-10 identifies estimates for non-contract costs; and total construction, capital, and annualized costs.

[1] This cost does not reflect a potential reduction that may result from TCID’s 2012 activities to replace turnout structures on the Truckee Canal. Replacement of these structures likely satisfies a portion of the actions to achieve the safety objective and could reduce the field cost by $1.7 million, which is not reflected here.

Table 5-10. Alternative 250.a Cost Summary

Measure Selected for Meeting the Safety Objective	Additional Measure(s) Selected for Meeting the Water Supply Objective	Estimated Cost ($ Million)
HDPE Cutoff Wall		$44.0
	Dry-Year Crop Insurance/Fallowing: see annual program cost below	
TOTAL FIELD COST		**$44.0**
Non-Contract Costs		
Planning and Environmental Compliance[1]		$4.40
Engineering and Design[2]		$4.40
Construction Management[3]		$4.40
Easements[4]		$0.40
Cultural Resources[5]		$1.40
TOTAL CONSTRUCTION COST		**$59.0**
Interest During Construction[6]		$2.00
TOTAL CAPITAL COST		**$61.0**
Interest and Amortization[7]		$2.80
Annual Operations and Maintenance[8]		$0.10
Dry-Year Crop Insurance/Fallowing Program[9] (25% demand reduction)		$3.60
TOTAL ANNUAL COST		**$6.50**

Note:

Cost estimate is appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimate is presented in January 2012 dollars, and may have discrepancies due to rounding.

[1] 10 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs.

[2] 10 percent of the field cost was estimated for Engineering and Design non-contract costs.

[3] 10 percent of the field cost was estimated for Construction Management non-contract costs.

[4] 1 percent of the field cost was estimated for Easements non-contract costs.

[5] 3 percent of the field cost was estimated for Cultural Resources non-contract costs.

[6] Interest During Construction was estimated over 2 years of construction at the current Federal discount rate of 4 percent.

[7] Interest and Amortization of the capital cost was estimated over 50 years at the current Federal discount rate of 4 percent.

[8] Annual Operations and Maintenance costs were estimated at 0.2 percent of the field cost.

[9] Dry-Year Crop Insurance/Fallowing Program annual cost is estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. This alternative would require 25 percent demand reduction in Truckee and Carson Division agriculture.

Key:

$ million = million dollars

HDPE = high-density polyethylene

Accomplishments

Safety

Alternative 250.a and all other alternatives formulated and selected by the Study meet the RR3 level of risk reduction required to achieve the Study's safety objective.

Water Supply

Iterations of Alternative 250.a showed that fallowing 25 percent of water-righted agricultural land in dry years is sufficient to achieve a desired level of reliability (see Appendix F). Alternative 250.a meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (95.7 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure 5-10, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-9,000 acre-feet, which meets the desired negative-10,000 acre-foot threshold.

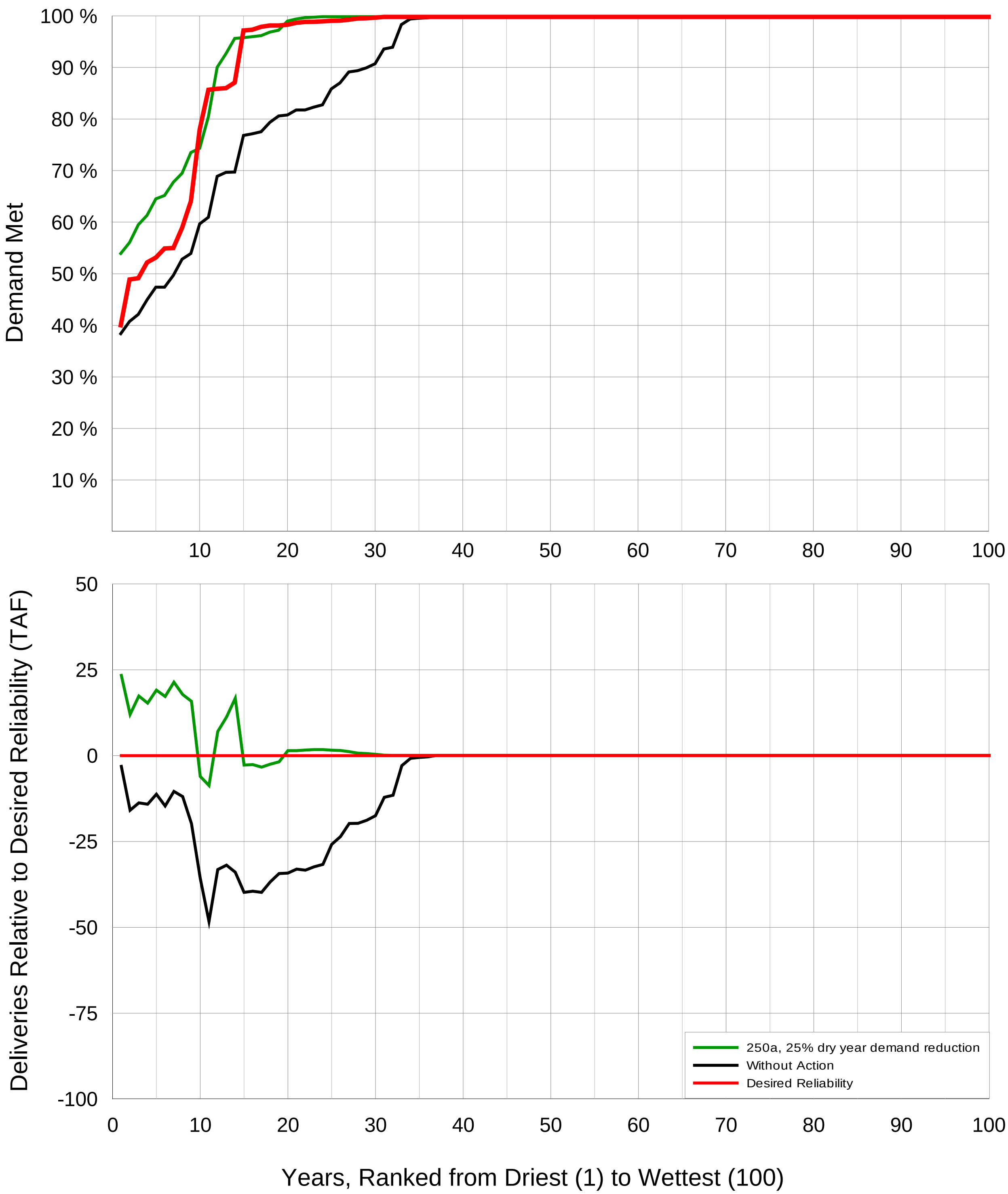


Figure 5-10. Water Supply Performance of Alternative 250.a

Project Efficiency

Alternative 250.a plans for a Project efficiency of 65 percent, and includes no actions to increase efficiency.

Seepage losses from the Truckee Canal are not reduced under this alternative.

Water Quantity and Quality on Lower Truckee River

The average annual volume of water in the lower Truckee River for Alternative 250.a is greater than that of the Desired Reliability condition but less than that of the Without-Action Alternative.

- **Relative to the Desired Reliability** – Increase in Truckee River flow of 28,000 acre-feet annually.

- **Relative to the Without-Action Alternative condition –** Decrease in Truckee River flow of 18,000 acre-feet annually.

Hydropower Generation

Annual hydropower generation is increased under Alternative 250.a relative to the Without-Action Alternative. Average generation at Lahontan Powerplant and 26-Foot Drop powerplant is 15,065 MWh and 4,722 MWh annually, respectively.

Preliminary Alternative Review

Environmental outcomes and regulatory requirements would be very similar to those under Alternative 350.a, when compared to the Without-Action Alternative. The Truckee Canal would be operated at a greater level than under the Without-Action Alternative, but at a lower level than the 350 cfs alternatives. Therefore, compared to the Without-Action Alternative, Lahontan Reservoir inflows and Carson River flows would increase, and Truckee River flows and Pyramid Lake inflows would decrease, but to a lesser extent than under the 350 cfs alternatives. Construction activities related to safety measures would be identical to those under Alternative 350.a. In addition, agricultural lands would be retired or fallowed.

Environmental Outcomes

Alternative 250.a's outcomes for species and habitat in the study areas would be similar to those for Alternatives 350.a, 350.b, and 350.d, when compared to the Without-Action Alternative: species that use the Lahontan Reservoir and Carson Lake would experience increases in water quality and quantity; wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may increase in extent; species in the Truckee River and Pyramid Lake would experience decreases in water quantity and quality; and wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake may decrease in extent (Reclamation 2000).

Deliveries to Lahontan Reservoir and the Carson Division would increase as compared to the Without-Action Alternative. Increased water availability within the Carson Division and return flows from agricultural users would benefit Stillwater NWR when compared to the Without-action alternative. Irrigation return flows may increase groundwater availability. Benefits of increased groundwater and drain flows would be less than under the 350 and 600 cfs alternatives, however, and would be offset by reduced return flows related to temporary land fallowing during dry years (Churchill County 2012).

Changes in land cover could also result in decreases in air quality from an increase in fugitive dust produced on fallow land (Churchill County 2012). This may be offset to some degree by reductions in air quality effects from agriculture, including application of agricultural chemicals, hydrocarbon emissions from vehicles and machinery, soot and ash from agricultural burning, and fugitive dust created by farm equipment; however, it is expected that the net effect of temporary land fallowing on air quality would be negative. Other temporary effects from fallowing could include an increase in noxious weeds, and decreased revenue for local businesses that support the agricultural industry (Churchill County 2012). Weeds and dust effects could be mitigated to some degree by continuing to apply some amount of water to the land (Brad Goetsch and Eleanor Lockwood, Churchill County, personal communication, August 25, 2011; public comments, August 2011). Previous examples of this effect within the Newlands Project include a portion of Swingle Bench where USFWS acquired and retired land without implementing such mitigation measures (public comments, August 2011).

The City of Fernley relies on seepage from the Truckee Canal to replenish the local aquifer, which is used for M&I purposes, although this is not a valid Project delivery. Studies have estimated that a minimum flow of 350 cfs is needed in the Truckee Canal to accommodate the level of aquifer recharge required for the City of Fernley to continue receiving an adequate level of municipal water withdrawals (City of Fernley 2012). The 250 cfs alternatives are also below the level needed to meet the City of Fernley’s aquifer recharge needs, thus potentially reducing Fernley’s ability to meet its total municipal demand.

Construction effects from the Truckee Canal safety improvements would be identical to those noted for alternatives 600, 350.a, and 350.b: construction activities could affect water quality and there is potential for construction noise to disturb nearby residents in some places.

Regulatory Review

A list of Federal, State, and local regulations that may be applicable is summarized in Table 5-1.

Federal Requirements Federal requirements for permitting and consultation are likely identical to those for alternatives 600, 350.a, and 350.b: informal consultation with the USFWS and USACE would take place, though no permitting requirements are anticipated at this time; consultation with the Pyramid Lake Paiute and Fallon Paiute Shoshone tribes would be required related to Indian Trust Assets; and consultation with the Nevada SHPO would be required to assess any potential negative effects on NRHP-listed project features. NEPA compliance would be necessary, but potential project effects may be able to be adequately addressed with an EA. Because of the range and complexity of potential environmental outcomes of Alternative 250.a, an EIS – rather than an EA – may be required to sufficiently evaluate effects.

State and Local Requirements State and local requirements for consultation and permitting are likely identical to those for alternatives 600, 350.a, 350.b, and 350.d, potentially including: a Surface Area Disturbance Permit from NDEP, Bureau of Air Pollution, and encroachment permits from Lyon, Storey, or Churchill counties.

Economics

TCID Ability to Pay

Under Alternative 250.a, TCID's ability to pay is estimated at $6.90 million annually. This is an improvement over the Without-Action Alternative of about $1.90 million.

Preliminary Benefits

All preliminary benefits for Alternative 250.a are estimated in relation to conditions under the Without-Action Alternative. Although not quantified in the Study, safety to the City of Fernley is a primary benefit of Alternative 250.a. Benefits to agricultural, wetlands and M&I water supplies factor in the average water supply reliability of 95.7 percent that occurs under Alternative 250.a. Average annual revenue from hydropower generation increases $0.09 million over the Without-Action Alternative. The annual benefit of increased agricultural water supply for the Project is estimated at $1.05 million. The annual benefit of increased supply to wetlands is $0.54 million. The annual benefit of increased M&I supply is estimated at $0.01 million.

Implementation Considerations

Compatibility with Applicable Laws, Policies, and Plans

Alternative 250.a is anticipated to be compatible with all existing laws and policies. It is also compatible with recent Truckee Canal rehabilitation actions taken by TCID to remove the 33 existing conduits to the laterals and replace them with 17 structures that include both lateral and stock line delivery features (TCID 2012b).

It is possible that the actions in Alternative 250.a may require a more extensive NEPA evaluation before implementation (see "Preliminary Alternative Review" subsection above), such as an EIS rather than an EA.

Federal and Non-Federal Roles and Responsibilities

Reclamation would likely be the Federal lead for permitting and NEPA compliance. As the local contractor, TCID would likely obtain State and local permits related to construction activities.

Potential for Cost-Sharing

TCID TCID should be considered a potential cost-share partner because Alternative 250.a significantly increases the water supply reliability experienced by its customers, which in turn improves its hydropower generation capacity—one of the largest sources of annual revenue for the district.

City of Fernley The City of Fernley should be considered as a potential cost-share partner for this Study alternative. The benefit of life safety and averted flood damage reduction would serve as a portion of the benefit that the city derives from Alternative 250.a. Additionally, Fernley receives the incidental benefit of continued seepage from the Truckee Canal into the local aquifer. By implementing this alternative, instead of another alternative that lines the Truckee Canal and reduces seepage, the city avoids the cost of replacing the groundwater supplies that they rely on.

Pyramid Lake Paiute Tribe The Pyramid Lake Paiute Tribe should be considered as a potential cost-share partner. Among the range of alternatives available for meeting the Study objectives, Alternative 250.a maintains a relatively high level of flows to Pyramid Lake.

Summary of Alternative 250.a

Table 5-4 below summarizes the performance, accomplishments, benefits, costs, and other characteristics of Alternative 250.a.

Table 5-11. Characteristics of Alternative 250.a

		Alternative 250.a	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	250 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	HDPE Cutoff Wall	-	NA
	Other Features	Fallowing 25% in Dry Years	-	NA
Safety		Meets RR3	Uncertain[12]	NA
Average Annual Project Water Delivery[1] (percent)		95.7%	90.5%	94.6%
Average Annual Project Delivery by User Category	Ag/Irrigation (TAF)	112.4	111.2	NA
	M&I (TAF)	13.3	13.2	NA
	Lahontan Valley Wetlands[2] (TAF)	67.4	63.6	NA
Annual Cost[3] (millions)		$6.50	NA	NA
TCID Ability-to-Pay[13] (millions)		$6.90	$5.00	NA[10]
Preliminary Benefits[6] (annual)	Agricultural Water Supply Reliability (millions)	$1.05	NA	NA
	Wetlands/ Environmental Water Supply Reliability[4] (millions)	$0.37[5]	NA	NA
	M&I Water Supply Reliability (millions)	$0.01	NA	NA
	Hydropower Generation Revenue (millions)	$0.09	NA	NA
	Safety[7]	Increased	NA	NA
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[8]	11.6	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[11]	Reduced by fallowing	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[9] (percent)	105%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	498	516	460[14]

Table 5-11. Characteristics of Alternative 250.a (contd.)

Notes:

[1] Long-term average annual percent of Newlands Project demand met.

[2] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[3] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[4] Based on volume of deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR, and also spills to Stillwater from Lahontan Dam. Excludes consideration of water supply from return flows and groundwater.

[5] May be lower due to reductions in other supply sources resulting from implementation of Study alternatives, but which could not be quantified.

[6] Preliminary benefits were estimated as the change between a Study alternative and the Without-Action Alternative for agricultural water supply, wetlands water supply, M&I water supply, and hydropower generation revenue. Water supply reliability under each Study alternative is factored into that alternative's benefits calculation. Benefits reported are annual, estimated over 50 years at the current Federal discount rate of 4 percent. For additional information, see appendixes D8, G1, and G2.

[7] The benefits of improved safety have not been quantified for this Study, but would need to be more fully evaluated for a feasibility study or for cost-allocation purposes.

[8] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[9] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[10] Assessment of financial conditions was not conducted for the Desired Reliability scenario, because this scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

[11] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[12] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the safety objective (RR3) is unknown.

[13] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[14] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:

Avg. = average

cfs = cubic feet per second

M&I = municipal and industrial

NWR = National Wildlife Refuge

RR = risk rating

TAF = thousand acre-feet

TCID = Truckee Canal Irrigation District

Alternative 250.b

Components and Features

Safety

HDPE Cutoff Wall Plus Other Structural Improvements Actions included to provide for safe operations of the Truckee Canal under this alternative are identical to the actions described for alternatives 600, 350.a, 350.b, and 250.a, and include the HDPE cutoff wall installed along approximately 17 miles of the canal embankment; replacement of turnout pipes, stockwater lines, and check structures; installation of check structures, wasteway turnout structures, and cross-drainages; increases in canal bank height; and removal of up to 115 trees.

Water Supply

Line Carson Division's Main Canals and Laterals Line 44.9 miles of conveyance facilities in the Carson Division with a 4-inch concrete geomembrane liner, consistent with the "Option 1 Expanded" recommendation in the *Newlands Project Efficiency Study* (Reclamation 1994). This includes portions of the V, S, L, and A canals, and part of the L1 lateral—facilities in which conveyance losses due to seepage are greatest, based on conclusions of the Efficiency Study. The extent of canal and lateral lining is the same as is described under Alternative 350.b, above.

Cost Estimates

The total annual cost for Alternative 250.b is $15 million.[1] Table 5-12 identifies estimates for non-contract costs; and total construction, capital, and annualized costs.

[1] This cost does not reflect a potential reduction that may result from TCID's 2012 activities to replace turnout structures on the Truckee Canal. Replacement of these structures likely satisfies a portion of the actions to achieve the safety objective and could reduce the field cost by $1.7 million, which is not reflected here.

Table 5-12. Alternative 250.b Cost Summary

Measure Selected for Meeting the Safety Objective	Additional Measure(s) Selected for Meeting the Water Supply Objective	Estimated Cost ($ Million)
HDPE Cutoff Wall		$44.0
	Line Main Canals and Laterals	$165.0
TOTAL FIELD COST		**$210.0**
Non-Contract Costs		
Planning and Environmental Compliance[1]		$10.0
Engineering and Design[2]		$21.0
Construction Management[3]		$21.0
Easements[4]		$2.00
Cultural Resources[5]		$6.00
TOTAL CONSTRUCTION COST		**$270.0**
Interest During Construction[6]		$50.0
TOTAL CAPITAL COST		**$320.0**
Interest and Amortization[7]		$14.5
Annual Operations and Maintenance[8]		$0.50
TOTAL ANNUAL COST		**$15.0**

Note:

Cost estimate is appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimate is presented in January 2012 dollars, and may have discrepancies due to rounding.

[1] 5 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs.

[2] 10 percent of the field cost was estimated for Engineering and Design non-contract costs.

[3] 10 percent of the field cost was estimated for Construction Management non-contract costs.

[4] 1 percent of the field cost was estimated for Easements non-contract costs.

[5] 3 percent of the field cost was estimated for Cultural Resources non-contract costs.

[6] Interest During Construction was estimated over 8 years of construction at the current Federal discount rate of 4 percent.

[7] Interest and Amortization of the capital cost was estimated over 50 years at the current Federal discount rate of 4 percent.

[8] Annual Operations and Maintenance costs were estimated at 0.2 percent of the field cost.

Key:

$ million = million dollars

HDPE = high-density polyethylene

Accomplishments

Safety

Alternative 250.b and all other alternatives formulated and selected by the Study meet the RR3 level of risk reduction required to achieve the Study's safety objective.

Water Supply

Alternative 250.b meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (96.2 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure 5-11, deliveries for Alternative 250.b exceed those for the Desired Reliability for each of the 100 years evaluated.

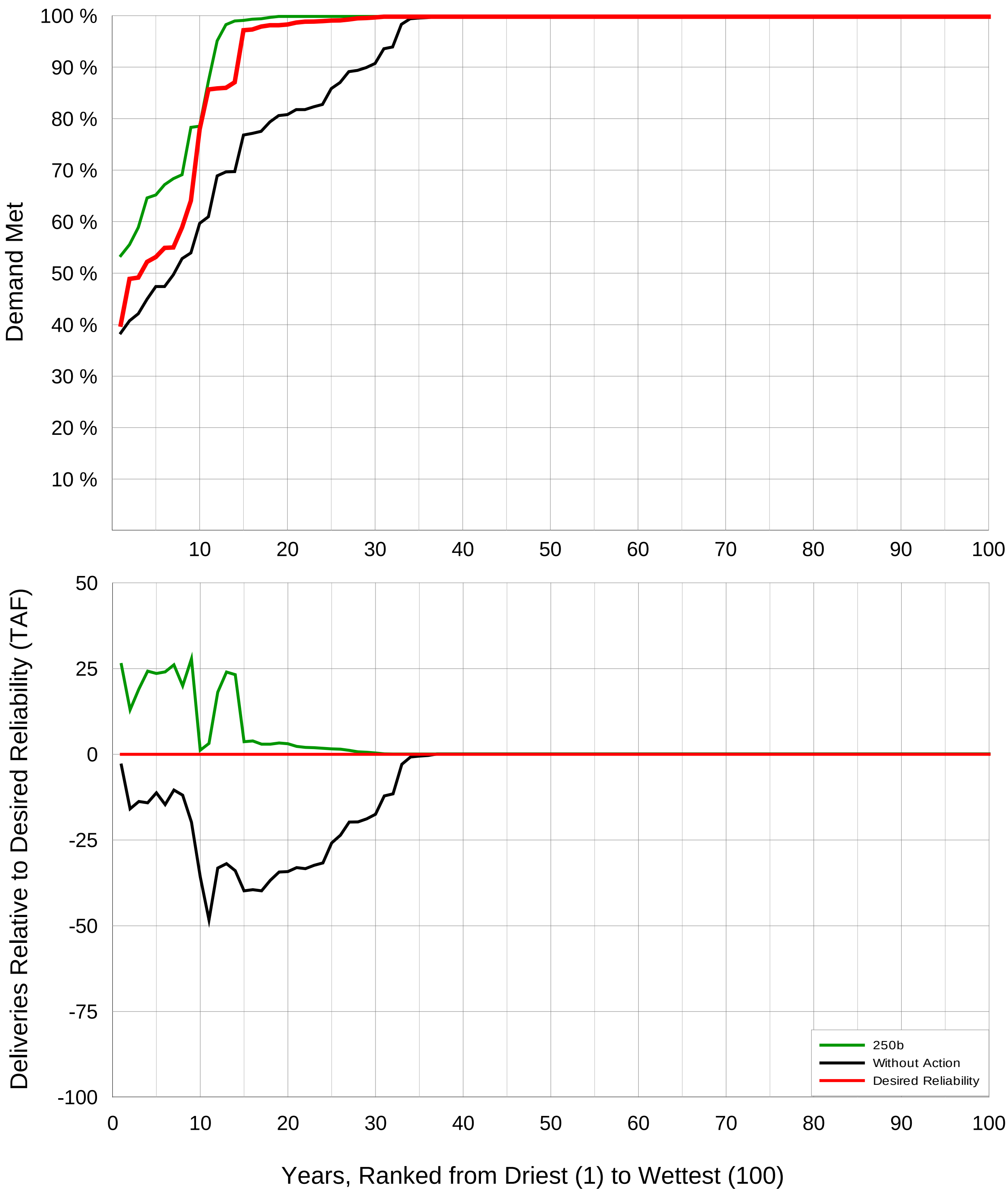


Figure 5-11. Water Supply Performance of Alternative 250.b

Project Efficiency

Alternative 250.b plans for increasing Project efficiency to 75 percent, with the associated increases in water supply being dedicated to Project water users.

Seepage losses from the Truckee Canal are not reduced under this alternative.

Water Quantity and Quality on Lower Truckee River

The average annual volume of water in the lower Truckee River for Alternative 250.b is close to that of the Without-Action Alternative.

- **Relative to the Desired Reliability –** Increase in Truckee River flow of 42,000 acre-feet annually.

- **Relative to the Without-Action Alternative condition –** Decrease in Truckee River flow of 4,000 acre-feet annually.

Hydropower Generation

Hydropower generation is increased under Alternative 250.b relative to the Without-Action Alternative. Average generation at Lahontan Powerplant and 26-Foot Drop powerplant is 14,696 MWh and 4,276 MWh annually, respectively.

Preliminary Alternative Review

Environmental outcomes and regulatory requirements would be similar to those under the 350.b alternative, when compared to the Without-Action Alternative. However, the Truckee Canal would be operated at a lower level than under 350.b, though still at a greater level than under the Without-Action Alternative. Therefore, compared to the Without-Action Alternative, Lahontan Reservoir inflows and Carson River flows would increase, and Truckee River flows and Pyramid Lake inflows would decrease, but to a lesser extent than under the 350 cfs alternatives. Reductions to groundwater availability in the Carson Division related to Carson Division canal lining would be the same as under Alternative 350.b. Construction activities related to safety measures would be identical to those under the 350.b cfs alternative.

Environmental Outcomes

Alternative 250.b's outcomes for species and habitat in the study areas would be similar to those for alternatives 600, 350.a, 350.b, and 350.d when compared to the Without-Action Alternative: species that use the Lahontan Reservoir and Carson Lake would experience increases in water quality and quantity; wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may increase in extent; species in the Truckee River and Pyramid Lake would experience decreases in water quantity and quality; and wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake may decrease in extent (Reclamation 2000).

No agricultural land retirement or fallowing is expected to occur under this scenario. Because of the increased Truckee Canal flows as compared to the Without-Action Alternative, irrigation return flows would be greater than under the Without-Action Alternative, and may increase groundwater availability in the Truckee Division. No substantial changes in land use or land cover are anticipated to occur under this scenario; therefore, no substantial changes in air quality from agricultural activities or changes in the extent of fallow land are expected to occur.

Deliveries to Lahontan Reservoir and the Carson Division would increase as compared to the Without-Action Alternative, which would benefit Stillwater NWR. Increased availability of groundwater and return flows within the Carson Division and would be identical or very similar under Alternative 250.b as under alternatives 600, 350.a, 350.d, and 250.a when compared to the Without-action alternative.

As with Alternative 350.b, this could be offset, however, by a reduction in seepage noted above from the main canals and laterals in the Carson Division, which could affect the reliability of local groundwater supplies for the City of Fallon, Churchill County, and NAS Fallon (Brad Goetsch and Eleanor Lockwood, Churchill County, personal communication, August 25, 2011). No permanent changes in land use or land cover are anticipated to occur under this scenario; therefore, no substantial changes in air quality from agricultural activities or changes in the extent of fallow land are expected to occur.

Additionally, as with Alternative 350.b, it is possible that with a reduction in groundwater, some Project landowners may seek to have their land reclassified from bottom land to bench land (public comments, August 2011). However, this Study has noted that even if a large proportion of Project lands were to be reclassified, the overall effect on Project demand would an increase of about 2 percent (see Appendix D4).

Outcomes for the City of Fernley's non-Project municipal supply, which relies on seepage from the Truckee Canal to replenish the local groundwater aquifer, would be similar to those for Alternative 250.a when compared to the Without-Action Alternative. The 250 cfs alternatives are also below the level of water that is needed in the canal to meet the City of Fernley's aquifer recharge needs, thus potentially reducing Fernley's ability to meet its total municipal demand (City of Fernley 2012).

Construction effects from the Truckee Canal safety improvements would be identical to those noted for alternatives 600, 350.a, 350.b, and 250.a: construction activities could affect water quality and there is potential for construction noise to disturb nearby residents in some places. As with Alternative 350.b, construction activities associated with canal lining in the Carson Division would result in similar effects to those related to the Truckee Canal, but in a larger geographic area.

Regulatory Review

A list of Federal, State, and local regulations that may be applicable is summarized in Table 5-1.

Federal Requirements Federal requirements for permitting and consultation are identical to those for alternatives 350.b and 250.a: informal consultation with the USFWS and USACE would take place, though no permitting requirements are anticipated at this time; consultation with the Pyramid Lake Paiute and Fallon Paiute Shoshone tribes would be required related to Indian Trust Assets; and consultation with the Nevada SHPO would be required to assess any potential negative effects on NRHP-listed project features. NEPA compliance would be necessary, and an EIS may be required to sufficiently evaluate effects.

State and Local Requirements State and local requirements for consultation and permitting are likely identical to those for all other alternatives, potentially including: a Surface Area Disturbance Permit from NDEP, Bureau of Air Pollution and encroachment permits from Lyon, Storey, or Churchill counties.

Economics

TCID Ability to Pay

Under Alternative 250.b, TCID’s ability to pay is estimated at $7.00 million annually. This is an improvement over the Without-Action Alternative of about $2.00 million.

Preliminary Benefits

All preliminary benefits for Alternative 250.b are estimated in relation to conditions under the Without-Action Alternative. Although not quantified in the Study, safety to the City of Fernley is a primary benefit of Alternative 250.b. Benefits to agricultural, wetlands and M&I water supplies factor in the average water supply reliability of 96.2 percent that occurs under Alternative 250.b. Average annual revenue from hydropower generation increases $0.04 million over the Without-Action Alternative. The annual benefit of increased agricultural water supply for the Project is estimated at $1.15 million. The annual benefit of increased supply to wetlands is $0.61 million. The annual benefit of increased M&I supply is estimated at $0.01 million.

Implementation Considerations

Compatibility with Applicable Laws, Policies, and Plans

Alternative 250.b is anticipated to be compatible with all existing laws and policies. It is also compatible with recent Truckee Canal rehabilitation actions taken by TCID to remove the 33 existing conduits to the laterals and replace them with 17 structures that include both lateral and stock line delivery features (TCID 2012b).

It is possible that the actions in alternative 250.b may require a more extensive NEPA evaluation before implementation (see "Preliminary Alternative Review" subsection above), such as an EIS rather than an EA.

Federal and Non-Federal Roles and Responsibilities

Reclamation would likely be the Federal lead for permitting and NEPA compliance. As the local contractor, TCID would likely obtain State and local permits related to construction activities.

Potential for Cost-Sharing

TCID TCID should be considered a potential cost-share partner because Alternative 250.b significantly increases the water supply reliability experienced by its customers, which in turn improves its hydropower generation capacity—one of the largest sources of annual revenue for the district.

City of Fernley The City of Fernley should be considered as a potential cost-share partner for this Study alternative. The benefit of life safety and averted flood damage reduction would serve as a portion of the benefit that the city derives from Alternative 250.b. Additionally, Fernley receives the incidental benefit of continued seepage from the Truckee Canal into the local aquifer. By implementing this alternative, instead of another alternative that lines the Truckee Canal and reduces seepage, the city avoids the cost of replacing the groundwater supplies that they rely on.

Pyramid Lake Paiute Tribe The Pyramid Lake Paiute Tribe should be considered as a potential cost-share partner. Among the range of alternatives available for meeting the Study objectives, Alternative 250.b maintains the highest flows to Pyramid Lake.

Summary of Alternative 250.b

Table 5-13 below summarizes the performance, accomplishments, benefits, costs, and other characteristics of Alternative 250.b.

Table 5-13. Characteristics of Alternative 250.b

		Alternative 250.b	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	250 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	HDPE Cutoff Wall	-	NA
	Other Features	Lining 45 miles of Carson Division canals	-	NA
Safety		Meets RR3	Uncertain[12]	NA
Average Annual Project Water Delivery[1] (percent)		96.2%	90.5%	94.6%
Average Annual Project Delivery by User Category	Avg. Annual Deliveries to Ag/Irrigation (TAF)	118.0	111.2	NA
	Avg. Annual Deliveries to M&I (TAF)	13.3	13.2	NA
	Avg. Annual Deliveries to Lahontan Valley Wetlands[2] (TAF)	67.8	63.6	NA
Annual Cost[3] (millions)		$14.50	NA	NA
TCID Ability-to-Pay[13] (millions)		$7.00	$5.00	NA[10]
Preliminary Benefits[6] (annual)	Agricultural Water Supply Reliability (millions)	$1.15	NA	NA
	Wetlands/ Environmental Water Supply Reliability[4] (millions)	$0.61[5]	NA	NA
	M&I Water Supply Reliability (millions)	$0.01	NA	NA
	Hydropower Generation Revenue (millions)	$0.04	NA	NA
	Safety[7]	Increased	NA	NA
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[8]	13.94	11.00	12.5
	Carson Division Groundwater and Agricultural Drain Flows[11]	Reduced by lining Carson Division canals	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[9] (percent)	105%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	512	516	460[14]

Table 5-13. Characteristics of Alternative 250.b (contd.)

Notes:

[1] Long-term average annual percent of Newlands Project demand met.

[2] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[3] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[4] Based on volume of deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR, and also spills to Stillwater from Lahontan Dam. Excludes consideration of water supply from return flows and groundwater.

[5] May be lower due to reductions in other supply sources resulting from implementation of Study alternatives, but which could not be quantified.

[6] Preliminary benefits were estimated as the change between a Study alternative and the Without-Action Alternative for agricultural water supply, wetlands water supply, M&I water supply, and hydropower generation revenue. Water supply reliability under each Study alternative is factored into that alternative's benefits calculation. Benefits reported are annual, estimated over 50 years at the current Federal discount rate of 4 percent. For additional information, see appendixes D8, G1, and G2.

[7] The benefits of improved safety have not been quantified for this Study, but would need to be more fully evaluated for a feasibility study or for cost-allocation purposes.

[8] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[9] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[10] Assessment of financial conditions was not conducted for the Desired Reliability scenario, because this scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

[11] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[12] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the safety objective (RR3) is unknown.

[13] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[14] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:
Avg. = average
cfs = cubic feet per second
M&I = municipal and industrial
NWR = National Wildlife Refuge
RR = risk rating
TAF = thousand acre-feet
TCID = Truckee Canal Irrigation District

Alternative 250.d

Components and Features

Safety

Actions included to provide for safe operations of the Truckee Canal under this alternative are identical to the actions described for alternative 350.d, and include the concrete geomembrane liner installed along approximately 17 miles of the canal; replacement of turnout pipes, stockwater lines, and check structures; installation of check structures, wasteway turnout structures, and cross-drainages; increases in canal bank height; and removal of up to 115 trees.

Water Supply

Line Truckee Canal As described for safety purposes above, line approximately 17 miles of the Truckee Canal with an impermeable membrane covered by unreinforced concrete.

Fallow 10 Percent of Water Rights During Dry Years Reduce demand from the Project by temporarily fallowing approximately 10 percent of water-righted Project agricultural land in dry years. Farmers who choose to forego their irrigation rights will be compensated.

Cost Estimates

The total annual cost for Alternative 250.d is $5.6 million.[1] Table 5-14 identifies estimates for non-contract costs; and total construction, capital, and annualized costs.

[1] This cost does not reflect a potential reduction that may result from TCID's 2012 activities to replace turnout structures on the Truckee Canal. Replacement of these structures likely satisfies a portion of the actions to achieve the safety objective and could reduce the field cost by $1.7 million, which is not reflected here.

Table 5-14. Alternative 250.d Cost Summary

Measure Selected for Meeting the Safety Objective	Additional Measure(s) Selected for Meeting the Water Supply Objective	Estimated Cost ($ Million)
Concrete/ Geomembrane Lining		$59.00
	Dry-Year Crop Insurance/Fallowing: see annual program cost below	
TOTAL FIELD COST		**$59.00**
Non-Contract Costs		
Planning (5%) and Environmental Compliance (7%)		$7.00
Engineering and Design (10%)		$5.80
Construction Management (10%)		$5.80
Easements (1%)		$0.60
Cultural Resources (3%)		$1.80
TOTAL CONSTRUCTION COST		**$80.0**
Interest During Construction (4 years, 4%)		$7.00
TOTAL CAPITAL COST		**$87.0**
Interest and Amortization (50 years, 4%)		$4.00
Annual Operations and Maintenance (0.2% of field cost)		$0.10
Dry-Year Crop Insurance/Fallowing Program (10% demand reduction)		$1.50
TOTAL ANNUAL COST		**$5.60**

Note:
Cost estimate is appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimate is presented in January 2012 dollars, and may have discrepancies due to rounding.
[1] 12 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs.
[2] 10 percent of the field cost was estimated for Engineering and Design non-contract costs.
[3] 10 percent of the field cost was estimated for Construction Management non-contract costs.
[4] 1 percent of the field cost was estimated for Easements non-contract costs.
[5] 3 percent of the field cost was estimated for Cultural Resources non-contract costs.
[6] Interest During Construction was estimated over 2 years of construction at the current Federal discount rate of 4 percent.
[7] Interest and Amortization of the capital cost was estimated over 50 years at the current Federal discount rate of 4 percent.
[8] Annual Operations and Maintenance costs were estimated at 0.2 percent of the field cost.
[9] Dry-Year Crop Insurance/Fallowing Program annual cost is estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. This alternative would require 10 percent demand reduction in Truckee and Carson Division agriculture.

Key:
$ million = million dollars
HDPE = high-density polyethylene

Accomplishments

Safety

Alternative 250.d and all other alternatives formulated and selected by the Study meet the RR3 level of risk reduction required to achieve the Study's safety objective.

Water Supply

Iterations of Alternative 250.d showed that fallowing 10 percent of water-righted agricultural land in dry years is sufficient to achieve a desired level of reliability (see Appendix F). Alternative 250.d meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) the long-term average delivery of Project water (95.5 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure 5-12, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-9,000 acre-feet, which meets the desired negative-10,000 acre-foot threshold

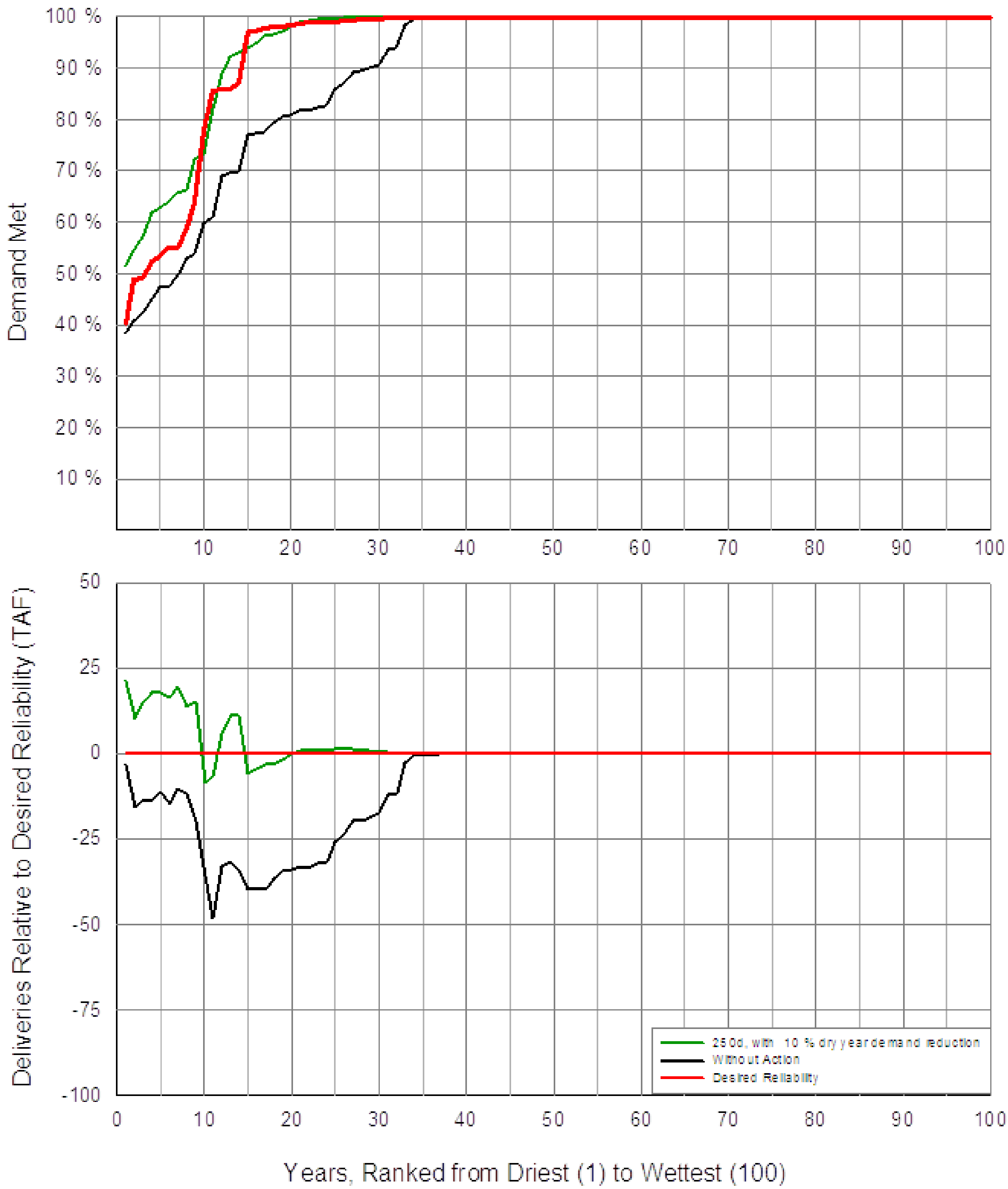


Figure 5-12. Water Supply Performance of Alternative 250.d

Project Efficiency

Alternative 250.d plans for a Project efficiency of 65 percent, and includes no actions to increase efficiency.

Seepage losses from the Truckee Canal are reduced by approximately 85 percent under this alternative.

Water Quantity and Quality on Lower Truckee River

The average annual volume of water in the lower Truckee River for Alternative 250.d is greater than that of the Desired Reliability condition but less than that of the Without-Action Alternative.

- **Relative to the Desired Reliability –** Increase in Truckee River flow of 31,000 acre-feet annually.

- **Relative to the Without-Action Alternative condition –** Decrease in Truckee River flow of 15,000 acre-feet annually.

Hydropower Generation

Hydropower generation is increased under Alternative 250.d relative to the Without-Action Alternative. Average generation at Lahontan Powerplant and 26-Foot Drop powerplant is 15,412 MWh and 4,808 MWh annually, respectively.

Preliminary Alternative Review

Environmental outcomes and regulatory requirements would be similar to those under alternatives 250.a and 350.d, when compared to the Without-Action Alternative. This alternative would have a similar level of water diversion as alternatives 250.a and 250.b, and the same construction effects as Alternatives 350.d. This would result in substantially less canal seepage, which would reduce the groundwater contributions in the Truckee Division. Temporary agricultural land fallowing would also occur under this alternative, and would result in similar effects as under Alternative 250.a, but to a lesser extent.

Environmental Outcomes

Alternative 250.d’s outcomes for species and habitat in the study areas would be similar to those for all other alternatives when compared to the Without-Action Alternative: species that use the Lahontan Reservoir and Carson Lake would experience increases in water quality and quantity; wetland and riparian areas adjacent to the Lahontan Reservoir and Carson Lake may increase in extent; species in the Truckee River and Pyramid Lake would experience decreases in water quantity and quality; and wetlands and riparian resources in the vicinity of the Truckee River and Pyramid Lake may decrease in extent (Reclamation 2000).

Deliveries to Lahontan Reservoir and the Carson Division would increase as compared to the Without-Action Alternative. Increased availability of groundwater and return flows within the Carson Division would benefit Stillwater NWR. The availability of these flows would increase when compared to the Without-action alternative, but to a lesser extent than under the 600 and 350 cfs alternatives, and would be offset somewhat by reduced return flows related to dry-year fallowing.

Similar to Alternative 250.a, changes in land cover could also result in decreases in air quality from an increase in fugitive dust produced on fallow land (Churchill County 2012). Other temporary effects from fallowing could include an increase in noxious weeds, and decreased revenue for local businesses that support the agricultural industry (Churchill County 2012). Weeds and dust effects could be mitigated to some degree by continuing to apply some amount of water to the land (Brad Goetsch and Eleanor Lockwood, Churchill County, personal communication, August 25, 2011; public comments, August 2011). Previous examples of this effect within the Newlands Project include a portion of Swingle Bench where USFWS acquired and retired land without implementing such mitigation measures (public comments, August 2011).

The City of Fernley relies on seepage from the Truckee Canal to replenish the local aquifer, which is used for municipal and industrial water, although this is not a valid Project delivery. Alternative 250.d's concrete geomembrane lining of the Truckee Canal would eliminate seepage into the local aquifer, thus reducing Fernley's ability to meet its total municipal demand (City of Fernley 2012).

Construction effects from the Truckee Canal safety improvements would be very similar or identical to those noted for Alternative 350.d: construction activities could affect water quality and there is potential for construction noise to disturb nearby residents in some places.

Regulatory Review

A list of Federal, State, and local regulations that may be applicable is summarized in Table 5-1.

Federal Requirements Federal requirements for permitting and consultation are identical to those for Alternatives 350.d: informal consultation with the USFWS and USACE would take place, though no permitting requirements are anticipated at this time; consultation with the Pyramid Lake Paiute and Fallon Paiute Shoshone tribes would be required related to Indian Trust Assets; and consultation with the Nevada SHPO would be required to assess any potential negative effects on NRHP-listed project features. NEPA compliance would be necessary, and an EIS may be required to sufficiently evaluate effects.

State and Local Requirements State and local requirements for consultation and permitting are likely identical to those for all other alternatives, potentially including: a Surface Area Disturbance Permit from NDEP, Bureau of Air Pollution, and encroachment permits from Lyon, Storey, or Churchill counties.

Economics

TCID Ability to Pay

Under Alternative 250.d, TCID's ability to pay is estimated at $6.90 million annually. This is an improvement over the Without-Action Alternative of about $1.90 million.

Preliminary Benefits

All preliminary benefits for Alternative 250.d are estimated in relation to conditions under the Without-Action Alternative. Although not quantified in the Study, safety to the City of Fernley is a primary benefit of Alternative 250.d. Benefits to agricultural, wetlands and M&I water supplies factor in the average water supply reliability of 95.5 percent that occurs under Alternative 250.d. Average annual revenue from hydropower generation increases $0.12 million over the Without-Action Alternative. The annual benefit of increased agricultural water supply for the Project is estimated at $0.99 million. The annual benefit of increased supply to wetlands is $0.46 million. The annual benefit of increased M&I supply is estimated at $0.01 million.

Implementation Considerations

Compatibility with Applicable Laws, Policies, and Plans

Alternative 250.d is anticipated to be compatible with all existing laws and policies. It is also compatible with recent Truckee Canal rehabilitation actions taken by TCID to remove the 33 existing conduits to the laterals and replace them with 17 structures that include both lateral and stock line delivery features (TCID 2012b).

It is possible that the actions in Alternative 250.d may require a more extensive NEPA evaluation before implemention (see "Preliminary Alternative Review" subsection above), such as an EIS rather than an EA.

Federal and Non-Federal Roles and Responsibilities

Reclamation would likely be the Federal lead for permitting and NEPA compliance. As the local contractor, TCID would likely obtain State and local permits related to construction activities.

Potential for Cost-Sharing

TCID TCID should be considered a potential cost-share partner because Alternative 250.d significantly increases the water supply reliability experienced by its customers, which in turn improves its hydropower generation capacity—one of the largest sources of annual revenue for the district.

City of Fernley The City of Fernley should be considered as a potential cost-share partner for at least feasibility assessments of Study alternatives. The benefit of life safety and averted flood damage reduction would serve as a portion of the benefit that the city derives from the Study alternatives.

Pyramid Lake Paiute Tribe The Pyramid Lake Paiute Tribe should be considered as a potential cost-share partner. Among the range of alternatives available for meeting the Study objectives, Alternative 250.d maintains a relatively high level of flows to Pyramid Lake.

Summary of Alternative 250.d

Table 5-15 below summarizes the performance, accomplishments, benefits, costs, and other characteristics of Alternative 250.d.

Table 5-15. Characteristics of Alternative 250.d

		Alternative 250.d	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	250 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	Lining	-	NA
	Other Features	Fallowing 10% in Dry Years	-	NA
Safety		Meets RR3	Uncertain[12]	NA
Average Annual Project Water Delivery[1] (percent)		95.5%	90.5%	94.6%
Average Annual Project Delivery by User Category	Avg. Annual Deliveries to Ag/Irrigation (TAF)	115.4	111.2	NA
	Avg. Annual Deliveries to M&I (TAF)	13.3	13.2	NA
	Avg. Annual Deliveries to Lahontan Valley Wetlands[2] (TAF)	67.2	63.6	NA
Annual Cost[3] (millions)		$5.60	NA	NA
TCID Ability-to-Pay[13] (millions)		$6.90	$5.00	NA[10]
Preliminary Benefits[6] (annual)	Agricultural Water Supply Reliability (millions)	$0.99	NA	NA
	Wetlands/ Environmental Water Supply Reliability[4] (millions)	$0.46[5]	NA	NA
	M&I Water Supply Reliability (millions)	$0.01	NA	NA
	Hydropower Generation Revenue (millions)	$0.12	NA	NA
	Safety[7]	Increased	NA	NA

Table 5-15. Characteristics of Alternative 250.d (contd.)

		Alternative 250.d	Without-Action Alternative	Desired Reliability Scenario
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[8]	12.7	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[11]	Reduced by fallowing	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[9] (percent)	56%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	501	516	460[14]

Notes:

[1] Long-term average annual percent of Newlands Project demand met.

[2] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[3] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[4] Based on volume of deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR, and also spills to Stillwater from Lahontan Dam. Excludes consideration of water supply from return flows and groundwater.

[5] May be lower due to reductions in other supply sources resulting from implementation of Study alternatives, but which could not be quantified.

[6] Preliminary benefits were estimated as the change between a Study alternative and the Without-Action Alternative for agricultural water supply, wetlands water supply, M&I water supply, and hydropower generation revenue. Water supply reliability under each Study alternative is factored into that alternative's benefits calculation. Benefits reported are annual, estimated over 50 years at the current Federal discount rate of 4 percent. For additional information, see appendixes D8, G1, and G2.

[7] The benefits of improved safety have not been quantified for this Study, but would need to be more fully evaluated for a feasibility study or for cost-allocation purposes.

[8] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[9] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[10] Assessment of financial conditions was not conducted for the Desired Reliability scenario, because this scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay.

[11] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[12] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the safety objective (RR3) is unknown.

[13] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[14] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:

Avg. = average

cfs = cubic feet per second

M&I = municipal and industrial

NWR = National Wildlife Refuge

RR = risk rating

TAF = thousand acre-feet

TCID = Truckee Canal Irrigation District

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Chapter 6 Alternatives Comparisons and Summary of Findings

This chapter summarizes major findings regarding alternatives for resolving safety concerns with the Truckee Canal while providing a desired level of water supply reliability for Newlands Project water rights holders.

Alternatives Comparisons

This section includes comparisons of the alternatives described and evaluated in Chapter 5, "Alternatives." The following types of comparison summaries are included:

- Overall features, accomplishments, and performance for all alternatives and the Without-action alternative.
- The estimated construction costs and annual cost developed for each alternative.
- The payment capacity for the Newlands Project water supply beneficiaries.
- Evaluations of each alternative based on the planning criteria of completeness, effectiveness, efficiency, and acceptability.

Features, Accomplishments and Performance

All Study alternatives were developed to achieve both the safety objective, which is to reduce risk from operating the Truckee Canal, and the water supply objective, which includes serving water rights holders at the Desired Reliability level. However, alternatives differ with regard to their additional achievements and effects, such as effects on various categories of water users or on hydropower generation.

Table 6-1 summarizes the information presented in the descriptions and evaluations in Chapter 5 to allow for cross-comparison of the features, accomplishments, and performance of each Study alternative. Where useful and available, information is also provided for the Without-Action Alternative and the Desired Reliability condition.

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Table 6-1. Summary of Study Alternatives

		Alternative 600	Alternative 350.a	Alternative 350.b	Alternative 350.d	Alternative 250.a	Alternative 250.b	Alternative 250.d	Without-Action Alternative	Desired Reliability Scenario
Major Features	Truckee Canal Flow Stage	600 cfs	350 cfs	350 cfs	350 cfs	250 cfs	250 cfs	250 cfs	150 cfs	900 cfs
	Truckee Canal HDPE Cutoff Wall or Lining	HDPE Cutoff Wall	HDPE Cutoff Wall	HDPE Cutoff Wall	Lining	HDPE Cutoff Wall	HDPE Cutoff Wall	Lining	-	NA
	Other Features	-	-	Lining 45 miles of Carson Division canals	-	Fallowing 25% in Dry Years	Lining 45 miles of Carson Division canals	Fallowing 10% in Dry Years	-	NA
Safety		Meets RR3	Meets RR3	Meets RR3	Meets RR3	Meets RR3	Meets RR3	Meets RR3	Uncertain[1]	NA
Average Annual Project Water Delivery[2] (percent)		96.5%	95.6%	97.3%	96.3%	95.7%	96.2%	95.5%	90.5%	94.6%
Average Annual Project Water Delivery by User Category	Ag/Irrigation (TAF)	118.3	117.2	119.2	118.0	112.4	118.0	115.4	111.2	NA
	M&I (TAF)	13.3	13.3	13.4	13.3	13.3	13.3	13.3	13.2	NA
	Lahontan Valley Wetlands[3] (TAF)	68.0	67.3	68.6	67.8	67.4	67.8	67.2	63.6	NA
Annual Cost[4] (millions)		$2.90	$2.90	$15.00	$4.20	$6.50	$14.50	$5.60	NA	NA
TCID Ability-to-Pay[5] (millions)		$7.30	$6.90	$7.40	$7.20	$6.90	$7.00	$6.90	$5.00	NA[6]
Hydropower Generation Revenue (millions)		$1.35	$1.35	$1.25	$1.35	$1.30	$1.25	$1.30	$1.20	-
Environmental and Other Effects	Avg. Annual Spill to Stillwater NWR from Lahontan Dam (TAF)[7]	12.6	12.1	14.3	13.2	11.6	13.9	12.7	11.0	12.5
	Carson Division Groundwater and Agricultural Drain Flows[8]	Significant change not anticipated	Significant change not anticipated	Reduced by lining Carson Division canals	Significant change not anticipated	Reduced by fallowing	Reduced by lining Carson Division canals	Reduced by fallowing	Reduced in comparison to current conditions	Similar to current conditions
	City of Fernley Demand Met[9] (percent)	115%	108%	108%	56%	105%	105%	56%	99%	121%
	Avg. Annual Flow to Pyramid Lake (TAF)	480	487	505	491	498	512	501	516	460[10]

Notes:

[1] The 150 cfs flow stage is believed to pose a lower risk to the Fernley area because the water elevation in the canal would be maintained at a level low enough to minimize the risk of destabilizing the canal embankment. However, this is not a solution specifically designed to reduce risk of operating the canal, and thus the degree to which it meets the Study's safety objective (RR3) is unknown.

[2] Long-term average annual percent of Newlands Project demand met.

[3] Includes deliveries to Carson Lake and Pasture, the Fallon Paiute-Shoshone Tribal wetlands, and Stillwater NWR.

[4] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee. For additional information, see Appendix E3.

[5] Ability to pay estimates represents potential maximum increases to charges that TCID could apply to their customers while maintaining farm profitability, and are not reasonable to use as the sole basis for capital investment decisions. Ability to pay has been estimated using Reclamation guidelines and relies substantially upon the 5-year average for crop prices, which are volatile and presently on the higher end of historical ranges. For example, if alfalfa prices fell from current levels ($155/ton) to levels experienced a decade ago ($125/ton), TCID ability to pay could be reduced by as much as $8.7 million per year. The estimated current ability of TCID to pay for projects and improvements beyond current obligations is $6.50 million per year. (See Appendix G.)

[6] Assessment of financial conditions was not conducted for the Desired Reliability scenario. This scenario was developed to estimate a historical water supply reliability under current regulations and does not represent a current or future ability to pay..

[7] Spills are not considered a Project delivery, but are included in the calculation of benefits to wetlands.

[8] Effects of alternatives on Carson Division groundwater and agricultural drain flows are not quantifiable, and are described in comparison to current conditions.

[9] The City of Fernley's municipal supply relies on groundwater available through incidental recharge from the Truckee Canal. While this is not a valid Project delivery, some alternatives would have the effect of reducing the availability of this groundwater. The demand met for the City of Fernley is noted as an environmental outcome. For additional information on how the Study evaluated the effects of Study alternatives on Fernley's ability to meet future demand, see Appendix B4.

[10] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:
Ag. = agricultural
Avg. = average
M&I = municipal and industrial
RR = risk rating
TAF = thousand acre-feet
TCID = Truckee Canal Irrigation District

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Costs

Table 6-2 summarizes estimated construction and annual costs for each of the Study alternatives. Total capital cost is the sum of total construction costs and IDC. IDC is the interest that accrues on a loan financing the construction of an alternative. It is computed over an estimated construction period for all alternatives, which varies from 2 to 8 years. Total annual costs for each alternative were estimated by interest and amortization of the capital cost over 50 years and at the current federal discount rate of 4 percent. Annual O&M costs were also estimated at 0.2 percent of the field cost, as well as program costs for alternatives that include dry-year fallowing programs.

Table 6-2. Cost Summary Comparison of Alternatives

	600	350.a	350.b	350.d	250.a	250.b	250.d
Safety Measure	Cutoff Wall	Cutoff Wall	Cutoff Wall	Lining	Cutoff Wall	Cutoff Wall	Lining
Water Supply Measure	-	-	Lining Carson Div.	-	Dry-Year Fallowing	Lining Carson Div.	Dry-Year Fallowing
Capital Cost							
Field Costs	$44.0	$44.0	$210.0	$59.0	$44.0	$210.0	$59.0
Non-contract Costs[1]	$15.0	$15.0	$60.0	$21.0	$15.0	$60.0	$21.0
Total Construction Cost[2]	$59.0	$59.0	$270.0	$80.0	$59.0	$270.0	$80.0
Total Capital Cost[3]	$61.0	$61.0	$320.0	$87.0	$61.0	$320.0	$87.0
Annual Cost[4]	$2.9	$2.9	$15.0	$4.2	$6.5	$15.0	$5.6

Notes:

Cost estimates are appraisal-level and subject to change in the future. Appraisal-level cost estimates are not suitable for requesting project authorization and/or construction fund appropriations. Cost estimates are presented in January 2012 dollars, and may have discrepancies due to rounding. Additional detail is discussed in Appendix E3 of this Report.

[1] Non-contract costs includes estimates for the following: 5 to 12 percent of the field cost was estimated for Planning and Environmental Compliance non-contract costs. 10 percent of the field cost was estimated for Engineering and Design non-contract costs. 10 percent of the field cost was estimated for Construction Management non-contract costs. 1 percent of the field cost was estimated for Easements non-contract costs. 3 percent of the field cost was estimated for Cultural Resources non-contract costs.

[2] Total construction cost is the sum of field and non-contract costs.

[3] Total capital cost is sum of construction costs and interest during construction (IDC). IDC was estimated over duration of the construction period, which ranges 2 to 8 years, and at the current federal discount rate of 4 percent.

[4] Annual costs include interest and amortization of the capital cost estimated over 50 years at the current federal discount rate of 4 percent. Costs also include annual operations and maintenance estimated at 0.2 percent of the field cost. For some alternatives with the Dry-Year Fallowing Program, annual costs for the program were estimated at $100 per acre of land fallowing plus an administrative cost at 20 percent of the fee.

Federal Planning Criteria

Table 6-3 compares the Study alternatives using the four P&G planning criteria described in chapters 2 and 4: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability (WRC 1983). The following section describes each criterion and comparative rankings for the alternatives.

Table 6-3. Relative Performance of Alternatives Against Federal Planning Criteria

		600	350.a	350.b	350.d	250.a	250.b	250.d	Without-Action
Completeness		High	High	High	High	Medium-to-Low	High	High-to-Medium	Does not achieve Study objectives
Effectiveness		High	High	High	High	High-to-Medium	High	High	
Efficiency		High	High	Medium-to-Low	Medium	Medium	Medium-to-Low	Medium	
Accept-ability	M&I Users	High	High	Medium	Low	High	Medium	Low	Low
	Wetlands Users	High	High	Medium	High	Medium-to-Low	Medium	High	Low
	Agricultural Users	High	High	High-to-Medium	High	Medium-to-Low	High	Medium	Low
	Truckee River Environmental Users	Low	Medium-to-Low	Medium-to-Low	Medium	Medium	Medium	Medium	High

Key:
M&I = municipal and industrial

Scale

Lower Performance — Higher Performance

Completeness

Completeness is the extent to which a given alternative provides and accounts for all necessary investments and other actions to ensure realization of the planned effects. The completeness of each alternative is identified through determining that all necessary components of actions are taken into account, including the degree to which it relies on other public or private plans, or the actions of others, to be successful. Assessing completeness is conceptual for this Study, as information also related to completeness on specific mitigation needs, and detailed designs and cost estimates would be developed at a future phase of study.

All alternatives developed by the Study are considered complete, however alternatives 250.a and 250.d rank lower for completeness because they rely on reducing overall agricultural demand in dry years through voluntary fallowing programs. The level of interest in these programs among irrigators is not certain or known.

The Without-Action Alternative was not ranked for completeness, as it does not meet the Study objectives.

Effectiveness

As described in Chapter 4, effectiveness is the extent to which an alternative addresses planning objectives and alleviates identified problems.

All Study alternatives are considered to be very effective, because they have been designed to meet both of the Study objectives, safety and water supply. Six of the 7 Study alternatives rank high for effectiveness. Alternative 250.a ranks slightly lower than the rest, because it relies heavily on the largest amount of dry-year land fallowing to achieve the water supply objective. While, from a technical standpoint, this provides a level of water supply reliability as high as other Study alternatives, it meets overall Project demand by encouraging one group of users not to exercise their water rights for the benefit of others. If part of the Study's water supply objective is to allow for the exercise of Project water rights, this alternative may provide a somewhat less-effective means of achieving that goal.

The Without-Action Alternative was not ranked for effectiveness, as it does not achieve the water supply objective and its effectiveness in meeting the safety objective is uncertain.

Efficiency

Chapter 4 describes the efficiency planning criterion as the extent to which an alternative is the most cost-effective and/or least complex means of alleviating the identified problems. As Study alternatives have a mostly high degree of effectiveness, the efficiency criterion is used to rank the combined expense, effort, or difficulty for each alternative to achieve that effectiveness. The most efficient plans would best address the Study objectives with the least cost, complexity, or potential environmental effects.

Alternatives 600 and 350.a are both judged as highly efficient, as they achieve both of the Study objectives through application of only one measure, the HDPE cutoff wall along portions of the Truckee Canal. These two are also the lowest-cost alternatives. Alternatives 350.b and 250.b are highly effective, but include an additional measure, lining portions of the Carson Division, to achieve the water supply objective that makes them the most expensive of the group; as a result, they are ranked medium-to-low for efficiency. The remaining alternatives are ranked medium for efficiency; they each include 1-3 measures to achieve both objectives at middle-range costs, but also carry potential environmental concerns for the communities in the primary study area.

The Without-Action Alternative was not ranked for efficiency, as it does not meet the Study objectives.

Acceptability

As described in Chapter 4, acceptability is the workability and viability of the alternative with respect to acceptance by Federal, State, and local entities and the public, as well as compatibility with existing laws, regulations, and policies. An alternative with less support is not infeasible or unacceptable; rather, it is simply less preferred.

An aggregate rank for acceptability was not developed for each alternative out of respect for the diversity of perspectives and interests with a stake in the Project's future. Instead, acceptability rankings are given for each board category of users or interests, both within the Project and without.

Each of the Study alternatives evaluated is compatible with existing laws, regulations, and policies.

Alternatives 600 and 350.a are judged to have a high level of acceptability for Project users and communities within the primary study area. For Truckee River users in the extended study area, Alternative 600 is likely to have a low level of support because it diverts the highest volume of flow from the Truckee River of any alternative. Acceptability for the Without-Action Alternative is the inverse mirror of Alternative 600: it may receive high support from upstream Truckee River environmental users, but it will reduce the Project's overall viability and may not fully address risk from the Truckee Canal.

For all other alternatives, acceptability is mixed and varies from high to low depending on how the measures included in each affect water supply for different uses or environmental conditions, especially for Project water rights holders.

Key Findings

Development of the above alternatives to meet the dual objectives of safety and water supply for the Newlands Project was the primary goal of this Study. However, the research and analysis conducted to support the planning process uncovered a number of other findings that are likely to be important considerations for additional studies related to the Project or to any alternative going forward. The Study's key findings are summarized as follows:

- **Canal Repairs are Possible to Address Safety Concerns –** The repair of the Truckee Canal such that it meets the Federal safety performance level (RR3) has been found technically possible in previous studies (see Chapter 1).

- **Project Water Demand Will Remain Steady –** While the complexion of the Project continues to change through implementation of ongoing water rights retirement and transfer programs, the fulfillment of these programs will not substantially diminish the potential volume of future water demand by Project water rights holders (see Chapter 3 and Appendix C).

- **Without Action, Canal Safety Issues Will Continue to Worsen –** A continuing significant need exists to implement actions to provide safety for the Truckee Canal. Without significant investments to improve the canal, its condition is expected to gradually worsen (see Chapter 3).

- **Action is Necessary to Preserve Water Supply Reliability –** Without addressing safety issues on the Truckee Canal, more stringent restrictions to canal conveyance capacities may gradually be implemented as the canal's condition worsens. These restrictions will significantly reduce the reliability of Project water supplies to levels significantly below expectations of agricultural, municipal and industrial, and environmental water users (see Chapter 2 and 3).

- **Alternatives Exist for Meeting Study Objectives –** Seven Study alternatives have been identified to satisfy the Study's objectives of safety and water supply, and are recommended for further development (see Chapter 5). The development of these alternatives revealed many constraints and potential opportunities for meeting the Study objectives, including:

  - **The Truckee Canal is Fundamental to the Project –** Plans that included either: (1) decommissioning the Truckee Canal and Derby Dam, or (2) allowing the canal conveyance capacity to be reduced over time to 150 cfs as a result of insufficient progress toward Reclamation safety requirements; were eliminated as viable alternative plans because the resulting conditions require far more extensive and expensive programs to support Project water rights than refurbishing the canal. For example, decommissioning the canal requires that between 50 percent and 80 percent of the Project's agricultural water rights would need to be retired permanently to meet the necessary level of reliability for the Project's remaining users, and cost three to 18-times as much as the cheapest alternative (see Chapter 4 and Appendix D3).

  - **Upstream Storage Looks Promising –** The use of upstream storage on the Truckee River for long-term storage of Project water was not evaluated, but appears very promising as an option for achieving the water supply objective. Allowing for Project credit water to be stored in Truckee River reservoirs may be a low-cost option for making flow stages below 600 cfs viable Truckee Canal capacities, but require substantial discussion with stakeholders to frame operational conditions (see Chapter 4 and Appendix D6).

  - **OCAP Limits Enhancements to Lahontan Reservoir Storage –** The regulations in OCAP that limit diversions from the Truckee River relative to storage targets in Lahontan Reservoir also limit the value of developing additional storage in Lahontan Reservoir. For example, a larger Lahontan Reservoir does capture more water during wet conditions but, because of OCAP storage target limitations, higher carry-over storages result in lower Truckee River diversions instead of higher water supply availability for the Project (see Chapter 4 and Appendix D7).

  - **Enhancing Carson River Inflows to Lahontan Reservoir Would Yield Marginal Benefit –** Acquisition of water rights from lower segments of the Carson River was considered because these would be the easiest to transfer to the Project; however, these rights are the least secure and provide little assistance during dry years, when additional supplies are needed most. The *Alpine* Decree prevents the secure transfer of rights from upper segments to Lahontan Reservoir, but even if it were possible, OCAP storage targets would reduce Truckee River diversions instead of improving Project supplies (see Appendix D5).

- **Study Alternatives Present Complex Tradeoffs –** Each of the alternatives is expected to appeal to different stakeholders and potential cost-share partners in different ways, because no single alternative benefits all groups or water uses equally. Selection of any alternative for implementation would also require balancing tradeoffs among broader, related issues within the region. For example:

  - **Higher Truckee River Flows Have Highest Cost –** The alternative with the lowest cost also has the lowest flow to Pyramid Lake (see Chapter 5).

  - **Some Alternatives Reduce Ancillary Supplies –** Alternatives that reduce diversions from the Truckee River also reduce spills from Lahontan Reservoir, which reduces the overall supply for the Lahontan Valley wetlands. Likewise, alternatives that include efficiency improvements may reduce regional groundwater resources (see Chapter 5 and Appendix F).

- **Reclamation is a Required Partner –** The implementation of any alternative to improve safety of the Truckee Canal and serve Project water rights will require involvement of Reclamation, due to the Federal government's: interest in serving water rights of Project users; interest in serving water rights to Tribes and Stillwater NWR; interest in operations that affect habitat for listed or special status species at Pyramid Lake; and, ownership of facilities requiring rehabilitation, such as the Truckee Canal.

- **Implementation Requires Non-Federal Partners –** Benefits of alternatives affect more than one party and include public safety, water supply reliability, and the possibility of addressing other related regional issues. Further, it is uncertain whether any singular entity is capable of paying for the alternatives identified by the Study. Potential cost-share partners with Reclamation include:

  – **TCID** and the Project's water right holders, for their shared interest in maintaining Project water supply reliability;

  – **City of Fernley**, for their shared interest in improving the safety of the Truckee Canal along its corridor through the city; and

  – **Pyramid Lake Paiute Tribe**, for their potential interest in how various alternatives influence flows on the lower Truckee River and other related issues, such as endangered species recovery and recoupment.

Given (1) the necessity to implement an alternative in order to reduce risk and serve water rights, (2) the complexity of preferences and benefits related to all alternatives, and (3) the unlikely ability of any single entity to fund an alternative without assistance, this Study recommends that TCID, the Pyramid Lake Paiute Tribe, the City of Fernley, Reclamation, and any other potential cost-share partners collaboratively develop a proponent-preferred alternative. A shared vision for a proponent-preferred alternative, with agreement among the potential partners that have been identified, has a higher potential for success.

Potential Next Steps for Implementing an Action

This Study identifies a range of alternatives for reducing risk from the Truckee Canal while providing for the reliable exercise of Project water rights in the future. Funding and legal authorization would need to be specified for any role that Reclamation plays in the implementation of a Study alternative.

At this time, Reclamation does not have funding allocated for the implementation of Study alternatives. Additionally, it is likely that any funding made available for Reclamation participation or implementation of any Study alternative would require both cost-share partnership(s) and repayment for Federal participation.

Some Study alternatives could be implemented under existing Reclamation authorizations, while others would require a new congressional authorization. Specific features of Study alternatives affect the ability of Federal and non-Federal partners to fund, finance, and implement them. The sections below describe potential pathways for implementing the alternatives presented in this Study.

Reclamation Implementation

The following sections describe potential funding sources and authorizations for Reclamation to participate in implementation of an alternative. Depending on the project and the source of authorization, some level of environmental compliance review will also be required.

Funding Sources

Reclamation could receive funds to implement an action from either (1) the Federal budget or (2) a cost-share partner. Reclamation's budget process is conducted in three-year cycles, meaning that, at the time that this report is released, the soonest that an alternative could be incorporated into Reclamation's budget would be Fiscal Year 2016. Funds received through the Federal budget process are subject to repayment conditions.

Reclamation Authorities

Reclamation has various authorities to implement projects, and each authority has specific limitations and requirements. Three authorizations may provide Reclamation with the authority to pursue Study alternatives, including (1) Replacements, Additions and Extraordinary Maintenance activities, (2) Extraordinary Operations & Maintenance, and (3) Construction. All of these options require repayment, cost-share with a local partner, and environmental compliance consistent with NEPA. Implementation of any Study alternative through Reclamation's Construction authorization would require an additional study to determine project feasibility. Reclamation must receive congressional approval before conducting a feasibility study.

Environmental Compliance

Authorizations that require environmental compliance and review under NEPA could also require the detailed development of Study alternatives, completion of environmental baseline studies, identification of potential impacts and mitigation features, development of a tentatively selected plan, completion of environmental compliance investigations, and, conduct of supporting technical analyses. These tasks will serve both Federal decision-making and NEPA compliance purposes.

As described in Chapter 5, the extent of environmental review necessary for implementation of any Study alternative is dependent on the potential environmental effects in the study area. Some alternatives may only require preparation of an EA, while others would be subject to more extensive analysis of an EIS.

EA/Finding of No Significant Impact

Preparation of an EA helps an agency determine whether an EIS is required; if environmental impacts of an action are not considered significant, the agency issues a Finding of No Significant Impact before commencing construction. An EA may be the appropriate extent of environmental review for Study alternatives that are not anticipated to result in significant impacts in the study area, such as those that rely primarily on a cutoff wall to resolve safety issues with the Truckee Canal.

An EA may be sufficient for two Study alternatives, 600 and 350.a, as described in Chapter 5.

EIS

Preparation of an EIS is likely appropriate for Study alternatives that include actions anticipated to affect groundwater, air quality, or socioeconomic conditions, or which would result in concerns related to environmental justice.

As noted in Chapter 5, an EIS would likely be required for Study alternatives 350.b, 350.d, 250.a, 250.b, and 250.d.

Local Proponent Implementation

Implementation of an alternative by a local proponent would require proponent funding and the review and approval of planned actions by Reclamation. TCID’s 2012 Truckee Canal conduit repair project is one example of a local proponent implementation.

Potential Funding Sources

Funding could be developed by a local entity or group of local entities, or provided by a state or the Federal government. Congressional approval of a Federal funding may require any or all of the following: a demonstration of feasibility, consistent with Federal planning guidelines; cost-share partner(s); documentation of environmental review and compliance; and repayment. Congress specifies which of these potential requirements are applicable for funding requests.

Federal funding requires an approximately 2-year lead time to insert line-items into the President’s budget. While this option may extend the overall schedule for implementation of any action, it offers more flexibility for financing.

Actions included in all Study alternatives could be authorized and funded by Congress.

Reclamation Review and Approval

Before being implemented, Reclamation must review and approve any plans that would modify or alter its facilities, or alter the ability of the Project to meet its objectives. Facilities of the Newlands Project that are discussed in Study alternatives include: Derby Dam, the Truckee Canal, Lahontan Dam, Carson River Diversion Dam, V and T Canals, and other Federally owned distribution and drainage canals within the Newlands Project.

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Chapter 7
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Chapter 8
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